FLIGHT & AIRCRAFT ENGINEER.

First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

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EDITORIAL COMMENT

IN a long speech delivered at Manchester before the holidays, Lord Weir made many interesting and withal reassuring statements with regard to the future of commercial aviation. We regret exceedingly that owing to the incidence of the Christmas holidays, and the consequent necessity of going to press early with last week's issue of "FLIGHT," it was impossible for us to reproduce or to comment on the speech. However, it was so important that we feel it is very much a case of better late than never, though we feel that an apology is due to our readers for our seeming lack of enterprise. Describing himself as an enthusiastic optimist, he nevertheless warned his audience, and through them the whole of the country, that at this highly critical period of the history of the new transport nothing but harm can come from not facing the facts, while the future might be gravely prejudiced by impatience for showy results. The success of the operational side of aerial transport, he pointed out, will depend upon measures which cannot be carried out in five minutes. These measures must be: The development of navigational instruction by really sound and severe training; the creation of an energetic meteorological service, specially designed to help air transport; the adoption of improved systems of wireless telegraphy and telephony, and the adoption of a first-class system of day and night marking of landing places and aerodromes. If these measures are taken, then he was quite clear that in five years' time there will be no more difficulty in navigating an aeroplane over a long course in foggy or otherwise bad weather than there is now in navigating a ship. If these measures are not taken, if hard and continuous experimental study is not put into the problems yet unsolved, then trouble, delay and discouragement will certainly ensue.

Lord Weir on the Future

It is just as well that these remarks of the Air Minister should be taken well to heart. "FLIGHT" has invariably pointed out that great as the possibilities of the future undoubtedly are, we must have patience—even infinite patience—if we are to reap the full fruits of the enterprise of the past and that which must be put into the future if we are to reach the full limit of progress which sane, sound policy can scarcely help achieving. We are glad, even thankful, that Lord Weir in the midst of his optimism has thought well to utter the very warning we ourselves have uttered more than once.

On the other hand, we have those within the movement who profess to see no particular future for commercial aviation within the British Isles, at any rate. At the other extreme, there are those who appear to think that all that remains now is that the restrictions on flying should be at once removed in order that we should be able to go straight ahead. As is always the case when such matters of high import are the subject of discussion, the truth lies midway between the two extremes of opinion. Undoubtedly, there is an enormous future before the movement, but we shall have to "gang warily" if that future is to be consummated to the full. Lord Weir is most certainly right when he says that nothing but grave prejudice to the future can result from impatience for showy results. As to the measures suggested to be adopted in advance of real development, it is unquestionable that the Minister is on thoroughly sound ground in his recommendations. Aerial navigation, in spite of all the War has taught us, is still an infant science, and we are still to some extent seeking for the sound methods which must be evolved before we can expect to make the navigation of the

air as certain as that of the seas. Much has been done towards attaining that end. In fact, so much has been done that it only remains to make the art of navigation in the air automatic, so to say. Compasses and instruments generally have long passed the stage of crudity in which the outbreak of war found them, and it is more in the manner of their use and the best methods of instruction and application that we have to make improvement than in the actual navigational instruments themselves. Again, there is the question of constituting a real and efficient meteorological system for assisting air transport. During the War the additional knowledge we have been able to gain of the conditions ruling in the upper air have taught us much, but that knowledge which we possess requires to be co-ordinated while we are seeking for still further improvement in the methods of forecasting the weather. Obviously, the comparatively loose system of storm warnings which sufficed for the mariner falls very far short of the requirements of the aerial navigator, for reasons which are so apparent that they need not be stated. Improved systems of wireless, both of telegraphy and telephony, must come into use. As a matter of fact, things have been accomplished during the War that are wonderful and have vastly simplified the problems of aerial navigation, and in this direction it is purely a question of amplifying what we already have in order to fit in with all the needs of commercial transport. Need for still further improvement there undoubtedly is, and just as certainly it will be achieved, since there is no finality in anything. The main thing is that in this direction the strides that have been made in the past four years will, when the facts can be disclosed, seem more like a page from a work of romance than a sober statement of achievement.

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No State Monopoly!

It is satisfactory to know that the present Air Minister is dead against anything in the shape of a State monopoly of commercial aviation. We trust most sincerely that his successor at the Ministry will hold the same views and continue along the lines of the same policy. Lord Weir does not believe that the best ends of civilisation would be served by keeping civil aviation for a Government monopoly. Co-operation between the activities of the State and the activities of the private firms would produce the finest results, he thinks. The State must be the pioneer; it must help, encourage, guide and exercise control; it must be in a position to say, "Thou shalt" and "Thou shalt not," but emphatically it must not monopolise. There must be a department of control, which must be in the charge of a few men, but of the best available men, who must be highly paid—men accustomed to wait patiently for results, and not men who want to be in the middle of next week before they have got over Sunday. Such a department must be broad-minded enough to engage the interest and enthusiasm of the biggest people for the biggest schemes. It must strive to acquire the best qualities of a private business, and it must function as far as possible like a private business, for a public end. This new department should spring out of the existing Air Ministry, which must be reconstituted and reorganised so as not only to control the administration of the Royal Air Force, but to act as the supreme authority for the development of civil aviation.

This all sounds very well indeed, and we should be quite content with the programme outlined if we knew that the Ministry was to remain in perpetuity under the administration of a business man like the present—or is it the late?—Air Minister. But before we can view it all with perfect content, we should like to see the draft of the proposed legislation which is to give effect to this programme. It seems to us—we are not at all inclined to cavil at the outline sketched by Lord Weir—that if such a programme were administered by a broad-minded business man it would come as near to the ideal as anything can in this very imperfect world. On the other hand, it is possible to see how it could, in other hands, come perilously near to being that very monopoly against which we have invariably raised our voice in protest. Experience of departments leads to the knowledge that, as a general rule, they are much fonder of the formula of "Thou shalt not" than of the permissive "Thou mayest," and it is here that the danger of overmuch control lies. Agreed that there must be control, and possibly a good deal of it, we shall have to watch very carefully what is done when the time comes for the actual terms of the regulating Acts of Parliament to be formulated.

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International Regulation of Flying

The first essential step to be taken by such a new department as that discussed by the Air Minister must be to settle the details of international communications, involving the settlement of an international aircraft convention. Such a convention has, said Lord Weir, already been drafted, and is being submitted to our Allies. If they substantially approve it, an International Air Conference will be held, and, he said, there was every reason to believe that within the next four or five months the principal nations of the world would have reached an agreement on this momentous matter. Similarly, domestic legislation will have to be passed for the regulation of flying in this country. The draft Bill has been prepared, and it is anticipated that within a few weeks after the assembling of the new Parliament a useful Act will come into force. Until this Convention and this domestic legislation become operative, there can be no private flying at all, either international or in this country.

It would be idle to endeavour to anticipate the ultimate shape to be taken by the foreshadowed legislation. It would be just as futile to try to lay down what should and should not be done, and exactly how. We can only wait and see what the proposals of the Government and of the nations agreeing to the Convention are like, and the effect they are likely to have on development, before proceeding to discussion or criticism. At the same time, we may be allowed to express the hope that the negotiations leading up to the conclusion of the International Convention will be made as public as possible. We do not want to find ourselves faced with accomplished and unalterable facts, which may be to the detriment of the future and which might have been changed or modified as the result of open discussion.

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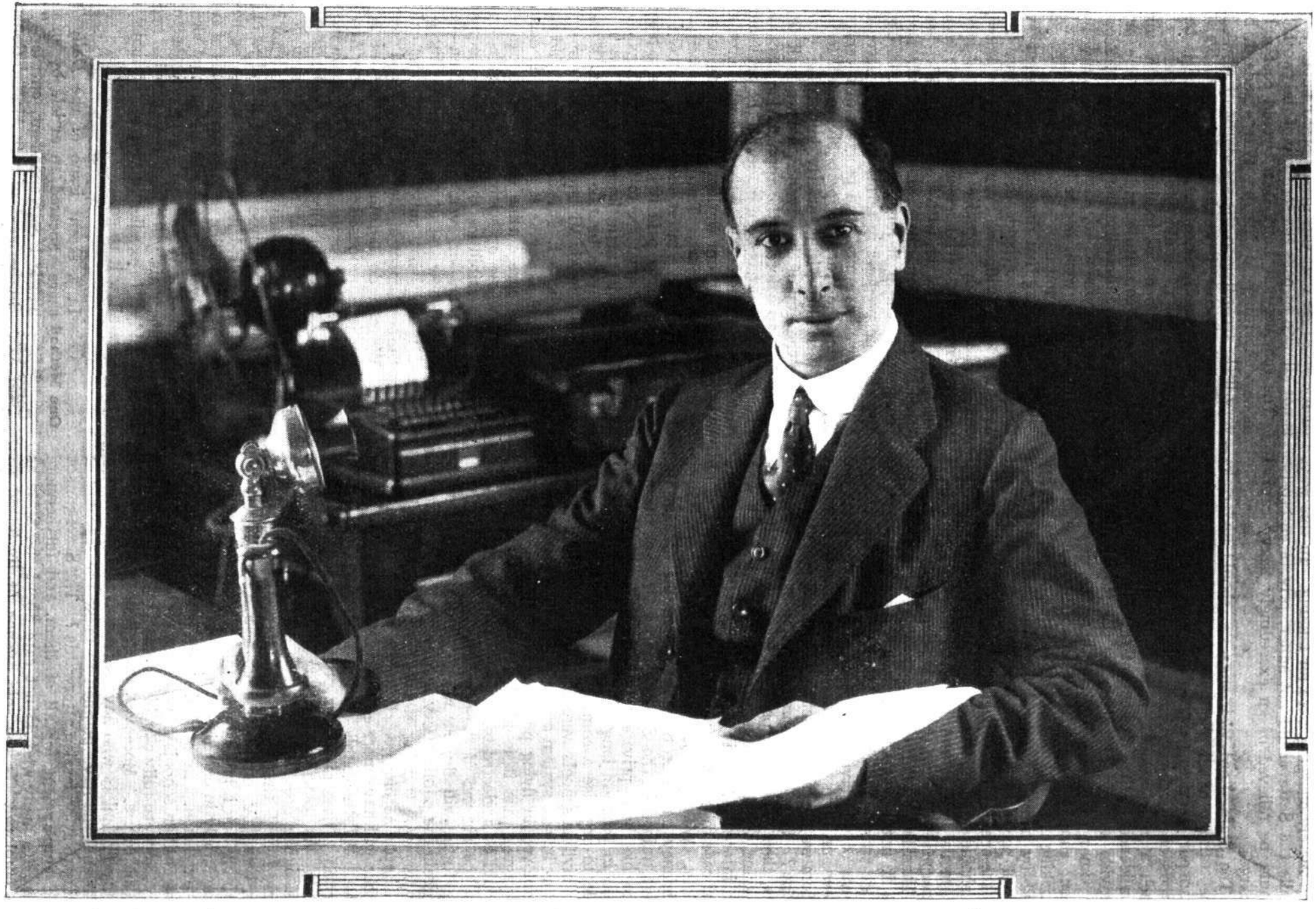
Domestic Legislation

Reverting to the question of domestic legislation, Lord Weir suggests that the State should acquire in permanence a large proportion of the existing military aerodromes, and should render them available for general use



The Rt. Hon. LORD WEIR OF EASTWOOD, P.C., Secretary of State for the Royal Air Force.

by leasing sheds to private operational companies and merely charging a fee for landing. In this way, while the State would not suffer, private enterprise would be relieved of an exceedingly heavy capital charge.

The State, Lord Weir suggests, should undertake the training of all pilots to be employed on public transport services, whether such services are in the hands of the department itself or in private hands. Such a course would, it is believed, secure public confidence in the efficiency of the pilots, and would provide a reserve of pilots for the Royal Air Force in times of emergency. Further, the new department should undertake the mapping out and the marking of aerial routes, the lighting of them by day and by night, and the inspection and certification of all private aircraft. Above all, it should attend to the special meteorological developments. Finally, it should be ready itself to undertake the carriage of mails, goods and passengers wherever private enterprise may be found lacking.

There is one point in this part of the programme that we do not like at all, and that is the reference to the State training of pilots. Does that mean the closing down of the civilian flying schools from which we drew our pilots at the beginning of the War, and to whom we owe a deep debt of gratitude on that count alone? If it does mean that, and it can mean no less, then we say the proposal is an eminently unfair one and should be fought tooth and nail by all who are interested. It is not as though there were any real case to be made out for the State training of all pilots. We are not aware that the standard of efficiency has ever been greater in the case of the pilot trained in the Service than in that of the one who has been privately taught, until the War had been in progress long enough for the services to be able to organise a complete system of training and the civilian schools were closed down. By all means let us have a system of State licensing of pilots to be employed in flying public service aircraft. In fact, we agree that it is highly necessary that nothing should be neglected to secure the safety of those who use the air and of those over whom the aircraft of the future will fly, but we are totally unable to see wherein the public safety is likely to be made greater by the mere training of pilots by the State. There is simply nothing at all in the argument that the public will have more confidence in the State trained pilot. All the public wants to reassure it is the certainty that pilots *are* properly trained for their work. As to where they are taught and by whom the public does not care two straws. It is unfortunate that the official view seems to be to the contrary. At once we have a State monopoly of training, and it gives one to think that, having secured a monopoly in one direction, there is always a danger of extension. In our view, it will not do at all. The civilian schools have done excellent work in the past, and are fully capable of turning out good pilots in the future. Moreover, what is to become of the many fine pilots who have served us well during the War and who have planned to make the teaching of flying their profession afterwards? The State cannot find employment for all of them, and furthermore there are many who do not care about the State as an employer. Is the sole avenue of livelihood to be closed to these men just because someone in authority wants to keep the training of pilots as a closed preserve? We trust not, and we look to those who have made the aerial interest in Parliament their own to see that this most objectionable proposal is not allowed to pass the scrutiny of the two Houses.

The scheme, said Lord Weir, would cost a lot of money according to the pre-War standard, but a very little according to the standards of war. However much it cost, it would not be expensive, for it would serve two ends, of which the value is beyond money. First, it would provide the country with a new and tremendous industry which in a supreme degree would constitute and maintain the arterial system of the great civilisation of the future. Secondly, it would do honour to, consummate, and justify the magnificent work begun by those who are dead and whom we mourn.

There is nothing that rings truer in the whole speech than this tribute to the dead. What we owe to their unselfish self-sacrifice we even yet do not know, nor can we adequately appraise the enormous advance we have made in aerial science as a result of it all. We have heard it said, with a strange lack of the true sense of proportion, that aviation has advanced by ten years in the past four. No-one should dare to appraise the progress in terms of time. Even if we say that we have made the progress of a century of peace during the War, it is probably to fall far short of the actuality—it is utterly impossible to even visualise the sum of the advance, and we shall do well simply to keep before us the appreciation that all the vast progress that has been made, all the achievement that stands to the credit of the men who have flown and who have built our warlike aircraft, has been paid for in blood and tears. The price of the admiralty of the air has been a bitter one, but it has been paid, and those who have paid it have left us a priceless legacy which we must see to it is not abused.

Judged along its main lines, there is not a great deal of exception to be taken to the draft scheme as set forth by the Air Minister save in the one direction we have indicated. It is a sane, sound and statesmanlike scheme as far as it goes. That it does not go beyond the bare outline of suggestion cannot be helped. The whole question is so enormous and so fraught with possibilities that it is quite impossible for any one man—or even number of men—to set down in detail now and at once even a tithe of the facts and factors that must enter into our calculations in the settlement of the future of aerial development. We can do nothing in the meantime but watch how it is proposed to translate the Air Minister's theories—for at the moment they are nothing but theories—into actual living facts. In thus setting down his ideas of the future, which we may be sure are shared with his co-adjutors in the Air Ministry, Lord Weir has certainly done a great deal to clarify the future. If he had done nothing else, he has at least given us the outline of a working basis of future progress and development. Incomplete and sketchy it has to be. The War is too recent and the future too full of uncertainty for it to be otherwise, and, as we have said, it is excellent so far as the limitations of the times allow it to go.

* * *

One Method of Correcting a Mistake

In a recent issue of the *Daily Mail* there appeared an article by an aeronautical correspondent, entitled "The Brotherhood of the Air." Generally speaking, it was an admirable enough article, but in one part of it the writer made an assertion which we thought and still think required

considerable qualification. Speaking of the opposition to the creation of the Royal Air Force as a single Service, the writer said :—

"There was yet another opposition to the R.A.F., and this, coming from a certain section of the aeronautical trade, was strongly voiced in the trade Press."

The context of the article suggested that for obvious reasons the "trade press" had placed commercial self-interest away in front of the National good.

We are not going to discuss the question at large or to debate whether there was opposition or not from a section of the trade and the aeronautical press. All we are concerned with is our own record in the matter. As to this, our readers know the attitude which has been taken up and maintained by "FLIGHT" ever since we first laid it down that it was desirable that the flying services should be separated from the Navy and Army and formed into a single service of their own. Desiring to dissociate ourselves from the statement made by the *Daily Mail*, we addressed the following letter to the Editor :—

"*December 23rd*, 1918.

"*To the Editor, the Daily Mail.*

"SIR,—Referring to the article entitled 'Brotherhood of the Air' by 'An Aeronautical Correspondent' in to-day's issue of the *Daily Mail*, the main facts, principles and position are most admirably summarised and dealt with by your correspondent. There is, however, one statement to which we take the most serious objection. He states :

"'There was yet another opposition to the Royal Air Force, and this, coming from a certain section of the aeronautical trade, was strongly voiced in the trade Press.'

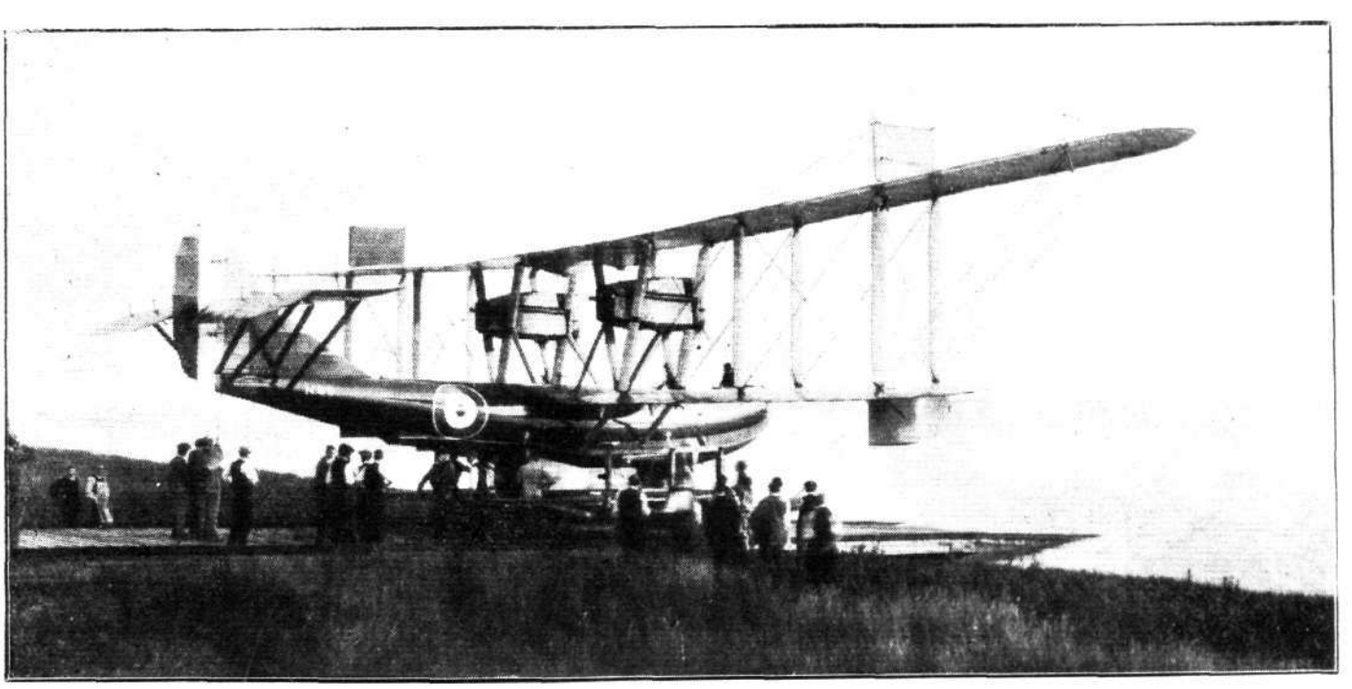
"Presumably the 'trade Press' in this instance includes 'FLIGHT,' and having regard to the fact that the creation of a single Air Service with an independent operating force, with one uniform and one badge, was first advocated in 'FLIGHT,' and was thereafter month in and month out hammered in as the only thing to be done to get maximum Air Service efficiency, and that at long last, in spite of the most virulent attacks from other quarters, the co-ordination took place, and entirely upon the lines laid down in 'FLIGHT,' your correspondent should hardly have slandered 'FLIGHT' so irresponsibly and light-heartedly as he appears to have done. We would ask you to publish this disclaimer in your very widely circulated paper, as we do not feel justified in allowing such a libel upon 'FLIGHT' and its Editor to stand uncorrected.

"Yours faithfully,
"THE EDITOR."

Our surprise may be judged when we found that the letter was not published, but that this extract had been made from it :—

"The Editor of 'FLIGHT' writes : 'The creation of a single Air Service, with an independent operating force, with one uniform and one badge, was first advocated in 'FLIGHT,' and was, month in and month out, hammered in as the only thing to be done to get maximum Air Service efficiency."

The clear inference that the casual reader would draw from this is that we had set ourselves to obtain a gratuitous advertisement of any services we may have been able to render in the direction indicated, whereas our sole object, as must be apparent from a perusal of the letter we wrote to the *Mail*, was to nail down what amounts to a libel on "FLIGHT." In the circumstances, we do not hesitate to say that the *Daily Mail* has not acted in consonance with the best traditions of journalism by suppressing the context of the paragraph it has done us the disservice to extract from our letter. These may be the methods of Carmelite House, but they are certainly not along the lines of common decency, let alone "cricket."



A PROMISING FLYING BOAT.—The "Phœnix-Cork," built by the Phœnix Dynamo Manufacturing Co., Ltd., of Bradford. This machine has put up some excellent performances after passing its experimental stage, but as the Armistice came along just as the machine was being put into production, it has not yet had an opportunity of proving itself extensively on active service. The machine is fitted with two Rolls-Royce "Eagle" engines.

THE LIBERTY ENGINE*

BY J. EDWARD SCHIPPER

IN spite of opposition during the first months of its production, the Liberty aircraft engine lately has been accepted as representing the highest class of engineering design. A strict censorship has been maintained over its details of construction, though the main specifications have been widely known for some time. It is, therefore, with unusual interest that the drawings, published herewith for the first time, will be scanned by engineers whose interest has been aroused but whose connections have not been such as to permit them to view the prints.

The Liberty engine, used in the De Haviland and other land planes and a great number of seaplanes, is a 12-cylinder V-type, with overhead valves and overhead camshaft. It has individual drawn steel cylinders with cylinder dimensions of 5 in. by 7 in., giving a piston displacement of 1649.34 cu. in. The cylinders are bolted to the upper half of the aluminium crankcase, the two sets making an angle of 45 deg. with each other. The water jackets are of pressed steel and are welded to the cylinders and at their own seam. An engine in all respects identical with the Liberty aircraft engine, but having cast iron cylinders, is fitted on "tanks," and one of the sectional views printed herewith shows this design.

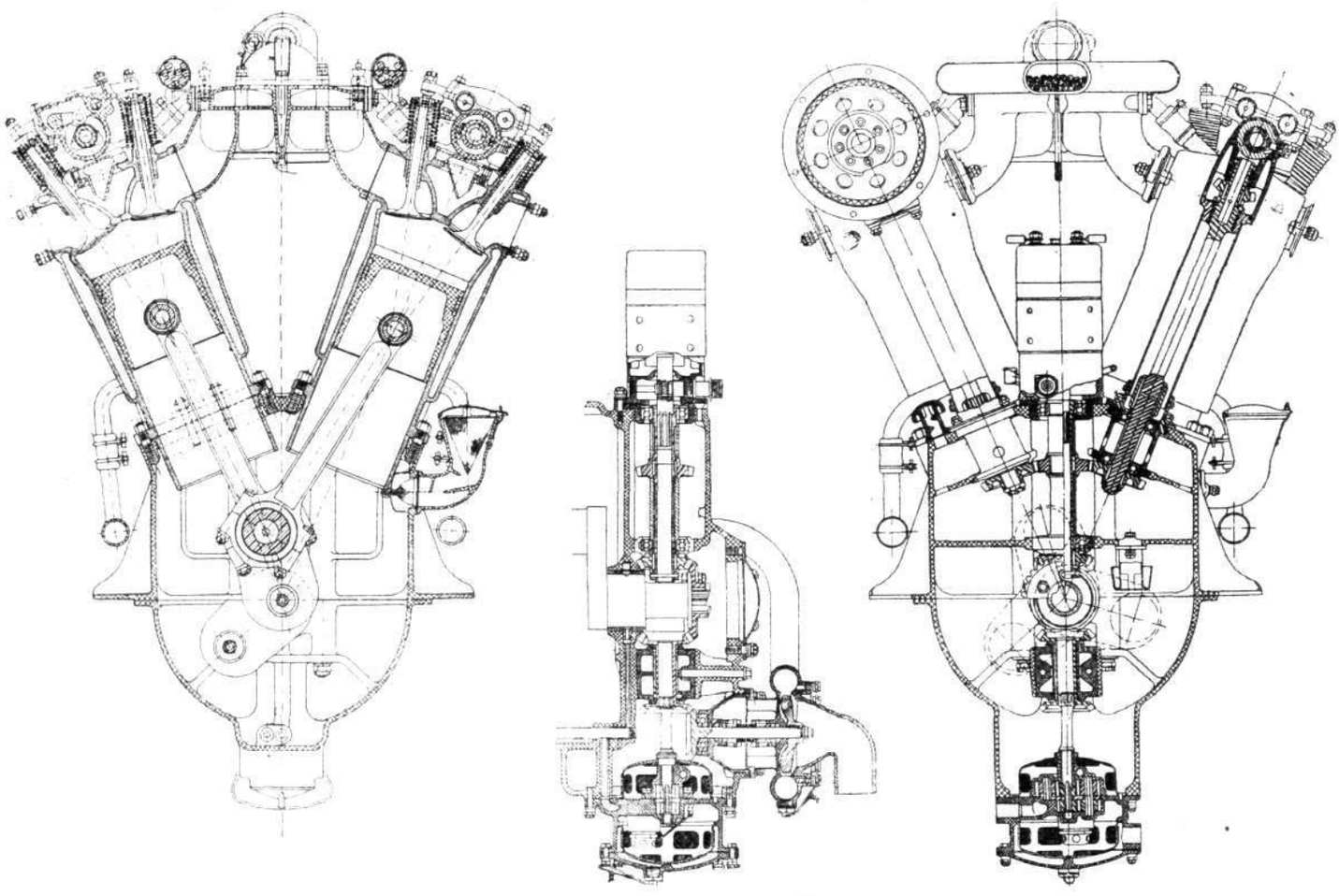
The valves are mounted in the heads of the cylinders and are inclined at an angle of 15° to the centre line of the cylinder, so that the angle made by the centre lines of the two valves is 30°. The intake manifold passes between the two rows of cylinders, and the carburettors in most of the installations are mounted in the V. The entire valve drive is housed above the cylinders and can be readily removed without tearing down the engine.

* By courtesy of *Automotive Industries*, N.Y.

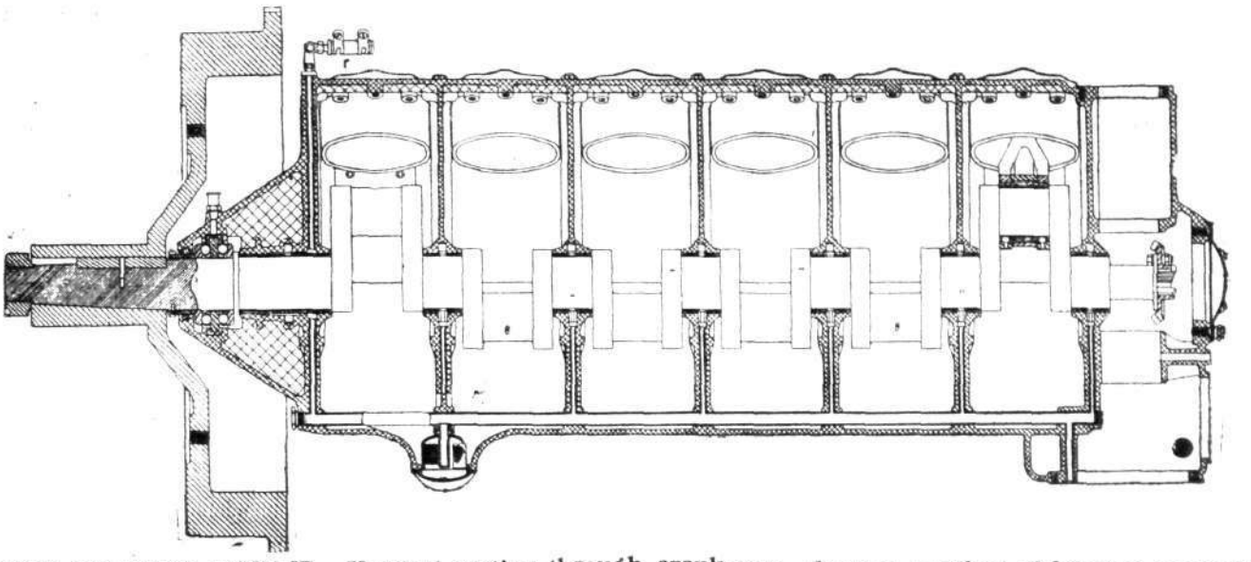
Weight and Output

The weight of the Liberty engine is approximately 806 lbs. and the brake horse-power developed ranges anywhere between 350 and 400 in the army type with the high compression pistons (18 per cent.) and 320 to 340 in the navy type with the low compression pistons (20.5 per cent.). The centre of gravity of the engine is on the centre line of the transverse section, 10 in. above the top of the engine supports and $\frac{5}{32}$ in. toward the distributor end of the engine from the centre of the middle bearing bolts. The rated fuel consumption is .54 lb. per brake h.p.-hour, or 36 gal. per hour with wide open throttle at 1,700 r.p.m. Under service conditions, about 30 gal. per hour is a fairly representative consumption. The oil consumption is .03 lb. per h.p.-hour or $1\frac{1}{2}$ gal. per hour with wide open throttle at 1,700 r.p.m. The horizontal flying speed of the engine is 1,700 r.p.m. and the ground speed is 1,600 to 1,625 r.p.m.

The pistons are of aluminium. There are two designs of pistons used, one for the army type and one for the navy. The army type pistons have a crowned head which gives an 18 per cent. compression space. The navy type pistons have a flat head which gives a 20·5 per cent. compression space. The pistons are 5 in. in length and have three rings of the eccentric type, all at the top of the piston. These piston rings are assembled with a gap between the ends of the rings not less than .025 in. The pistons weigh 3 lb. 3 oz., and the number of ounces that the pistons weigh over 3 lb. is stamped in the depression on the side of the piston, so that in assembly it is possible to pick out pistons of similar weight. The piston casting has an unribbed section and is fairly heavy, the section being $\frac{1}{2}$ in. thick at the head and at the rings and tapering to $\frac{1}{4}$ in. at the end of the piston skirt.



THE LIBERTY 12-CYLINDER ENGINE.—The view on the left shows the engine with cast-iron cylinders, as used on tanks, while the view on the right shows it with steel cylinders and sheet metal jackets. Below is shown a section through the camshaft, oil pump and water pump drives at the forward end of the engine.



THE LIBERTY ENGINE.—Vertical section through crank-case, showing method of bearing support and oil distribution.

I-beam connecting rods are used, the connecting rod length being 12 in. between centres. The piston pin is a seamless steel tube, the tube being a drive fit into the bosses on the aluminium piston. The tube is of $1\frac{1}{4}$ in. outside diameter, and is surrounded by a bronze bushing, upon which the upper end of the rod bears. The rod has a solid head and its lower end is either solid or forked, depending on whether it is for the left or right cylinder. The left rods are forked and the right plain. In assembly, the connecting rods are stamped with the serial number of the crankshaft to which they are fitted and also with the number of the cylinder in which they belong. In this way, it is possible to reassemble the Liberty engine and be certain that the rods are returned to the proper cylinders.

The clearance between the lower connecting rod bushings and the crank pin varies from ·003 in. to ·004 in. The allowable end play is from ·010 in. to ·020 in. The plain rods have two cap bolts and the forked rods have two for each side, or four.

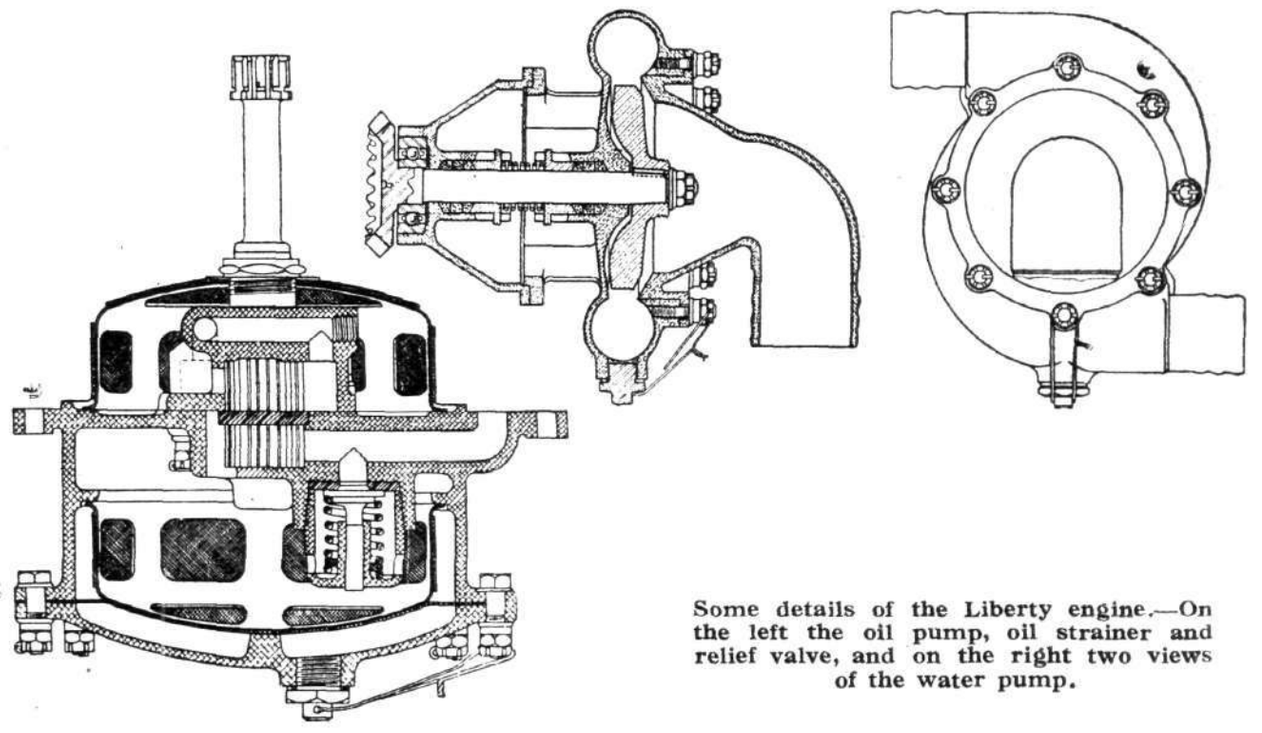
Bearings Between Halves of Case

A drop-forged seven-bearing crankshaft, $2\frac{5}{8}$ in. in diameter, is used. The shaft carries a propeller hub at its forward end and at the rear end carries a bevel gear for driving the valve mechanism. A double row thrust bearing at the propeller hub end of the crankshaft takes the end thrust on the shaft. The shaft is drilled for oil passage, the openings being drilled through the crank cheeks through the crank-pins. The propeller hub is lapped to a fit on the shaft, the end of the crankshaft is tapered and when the hub is fitted on it should be about ·001 in. tighter at the large end of the taper than at the small end. In addition to the taper fit, there is a key in the end of the crankshaft to take the propeller hub.

The crankcase is in two pieces, both of which are aluminium castings. The crankshaft bearings are on a line with the split in the crankcase, the lower halves of the crankshaft bearings being held in the lower half of the crankcase and the upper halves in the upper half of the crankcase. The two halves are tied together by long bolts or studs which pass through the upper half of the crankcase, through bosses, the nuts being at the top of the upper half of the case. This gives an accessible construction which is at the same time rigid. A careful joint is made between the two halves of the crankcase in order to secure the desired alignment at the main bearings, the joint being lapped.

Valve Gear

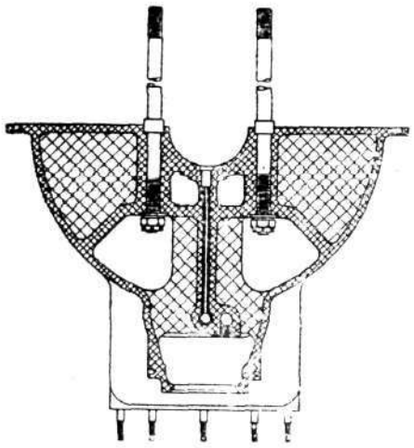
The valve drive is arranged as follows: From the bevel gear on the end of the crankshaft motion is transmitted to a vertical shaft located on the distributor end of the engine, or the end opposite from the propeller hub. This shaft has an intermediate gear which engages with the two cam driving shafts running parallel with the centre lines of the cylinder blocks. The vertical shaft which carries the lower bevel gear and the intermediate gear is carried on a



Some details of the Liberty engine.—On the left the oil pump, oil strainer and relief valve, and on the right two views of the water pump.

single row ball bearing at the upper end and a single row ball bearing just above the bevel gear at the lower end. The camshaft driving shafts are carried on two single row ball bearings at their lower end and in a bronze bushing at the upper end.

The drive is taken from this point to a bevel gear on the end of the camshaft which actuates the valves. The camshaft assembly consists of a camshaft with the cams integral, the cam-



Cross section through lower half of crank case of Liberty engine.

shaft bearing, camshaft driving gear, rocker levers, camshaft housing together with the covers, and also the camshaft driveshaft with the gear, bearings and camshaft driveshaft housing. The two camshaft assemblies for the left and right rows of cylinders are identical and are interchangeable, with the exception of the camshafts themselves and the camshaft housing covers. Each shaft is stamped with a serial number on the soft plug in the end of the camshaft opposite the flanged end. The right hand shafts are marked R and the left hand shafts are marked L. The housing covers are machined in place on the housing.

The valves are operated from the camshaft by means of roller cam followers which actuate the rocker shaft and in turn the valve rocker arms. The valve rocker arms bear directly on the valve stems by means of an adjusting bolt directly on the ends of the valve stems. The valves are set into the cylinders on an angle of 15 deg. to the centre line. The valves are the standard mushroom type with 45 deg. seat. The cylinder heads are bushed for the valves and the valve springs are of the double concentric type. The adjustment for the clearance between the end of the valve stem and the valve pushrod is made by turning the screw in the end of the rocker or pushrod and then locking it by means of the nut on the top of the rocker. This nut is locked by a cotter pin and is a castellated type. The clearance on the exhaust valve is ·019 to ·021 in. and on the inlet, ·014 to ·016 in.

Ignition System

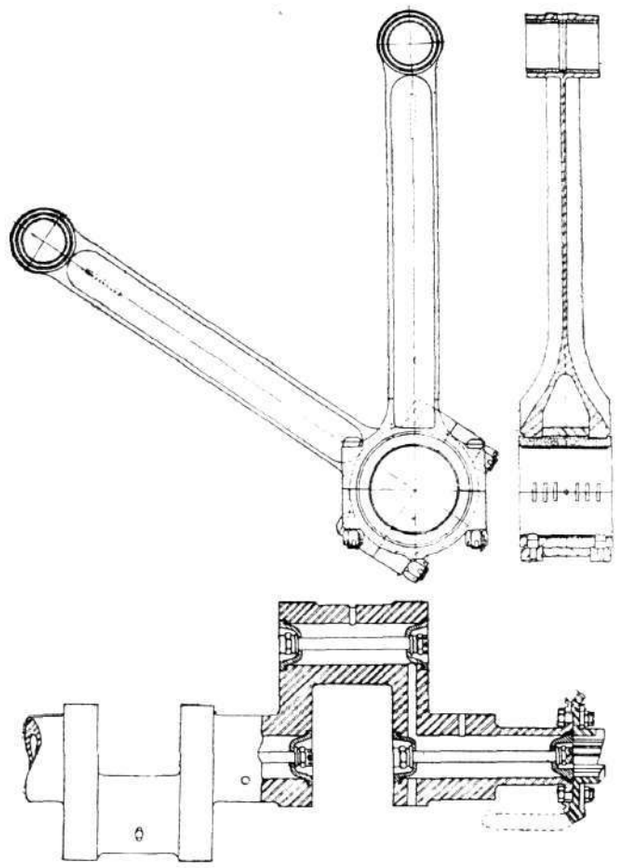
The distributor is mounted on the ends of the camshaft and arranged to fire 1L, 6R, 5L, 2R, 3L, 4R, 6L, 1R, 2L, 5R, 4L, 3R. The ignition system used on the Liberty 12 is the battery type with two independent breaker and distributor mechanisms, identical in every respect and each one firing all 12 cylinders. These distributors are supplied with electrical energy from two sources. For starting and idling speeds up to 650 r.p.m. current is drawn from the specially constructed four-cell storage battery which has sufficient capacity to ignite the engine at full speed for three hours and it is so constructed that it will function properly upside down. The generator builds up so that it takes up the load at 650 r.p.m.

Two main circuit breakers connected in parallel are located in each distributor box and the two circuit breakers are timed to operate simultaneously. Circuit breakers are provided in duplicate as a precautionary measure. There is also an additional circuit breaker to prevent the production of a spark when the engine is turned backward or rocked. The auxiliary breaker is connected in parallel with the other two through a resistance unit which reduces the amount of current flowing through it. The breaker is so timed that it opens slightly before the other two when the engine is turned in a forward direction. When the engine is turned in a backward direction, the main breakers open first and no spark is produced, because the auxiliary breaker permits the current to continue to flow through the coil, but in diminished quantity, owing to the resistance unit. The distributor shaft is carried on two ball bearings.

The generator is driven from the same vertical shaft which drives the two camshaft driving shafts, the drive being taken off the upper end of this shaft. The generator rests in a vertical position above this shaft on the centre line of the engine between the two rows of cylinders. By simply removing one flat head screw the entire generator driveshaft assembly can be lifted out. The mesh between the lower generator driveshaft gear and the crank gear is adjusted by pins between the bearing container at the top of the shaft and the crankcase.

The oil supply for the Liberty engine is carried in a reservoir which is cooled. This reservoir is mounted somewhere in the vicinity of the engine and from it oil is led to the connection on the right side of the oil pump body, which is marked in raised letters "Oil In." The oil is filtered at this point through a large-area, fine mesh screen. A delivery pump of the gear type takes the oil after it has passed through the screen, and delivers it under pressure to a distributor pipe running the entire length of the crankcase. There is a pressure-regulating valve between the pump and the distributing pipe which holds the pressure so that it does not exceed 50 lbs. per square inch.

From the distributor pipe there are pipes fitted in the crankcase leading to the main crankshaft bushings. The crankshaft is hollow, and in the centre of each main bearing there is a radial hole drilled through the shaft into the hollow



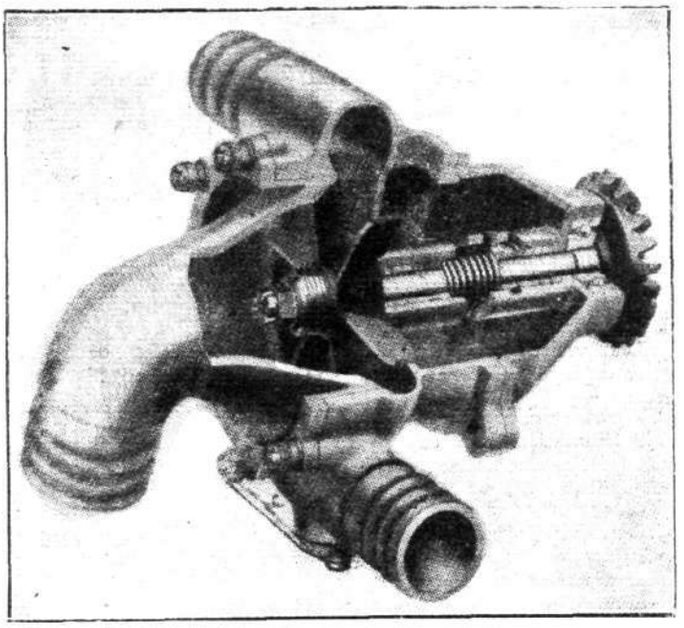
Liberty con. rod assembly in side view and section. Bottom: Detail of crankshaft, showing method of plugging bores.

centre. A passage leads from each hollow main bearing to the adjacent crank pin, which is also hollow. A radial hole is drilled through each crank pin, and carries the oil out on the surface of the pin. There are oil grooves and passages in the connecting rod bushings to ensure proper lubrication for both the forked and plain connecting rods.

Lubrication of Piston Pins

The oil spray thrown off by centrifugal force from the ends of the connecting rods lubricates the piston pins and cylinder walls. A part of the oil conducted to the crankshaft

main bearing at the propeller end of the engine goes through a passage around this bearing and up through pipe leads to the propeller end of the camshaft housings. From the end of the camshaft housing it is led around the end of the camshaft bearing through a passage drilled diametrically through



Sectioned view of Liberty water pump.

the bearing midway of its length. Once every revolution of the camshaft, a hole drilled through the camshaft into its hollow centre registers with the oil passage through the bearing.

Lubrication of Valve Mechanism

Thus once every revolution of the camshaft a small quantity of oil is forced into the hollow camshaft. The oil is led through the camshaft and out through holes drilled in it to each camshaft bearing. The excess works out at the end of these bearings and collects in small pockets to the depth of about ¼ in. The cams, in revolving, dip into this oil and splash it over the cam rollers and into pockets in the rocker lever shafts. From these pockets it is led through the hollow rocker shafts to the rocker shaft bearings.

The excess oil eventually finds its way to the gear end of the camshaft housings, over the gears and down the driveshaft housing into a chamber just above the oil pump.

The excess oil thrown off in the crankcase by the connecting rods collects in this same chamber when the engine is inclined, so that the propeller end of the engine is high. If the propeller end of the engine is low, this oil collects in a small sump or chamber at the propeller end of the crankcase.

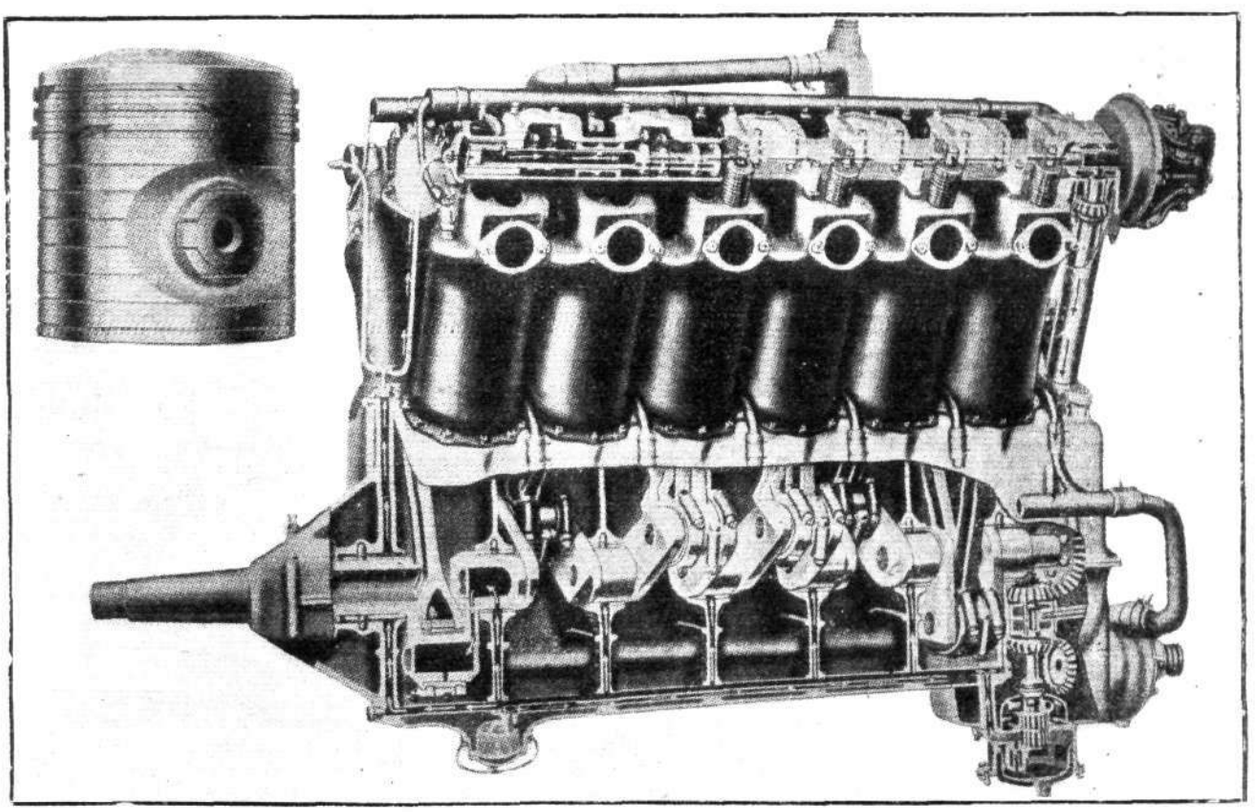
Immediately above the oil delivery pump is located an oil return pump consisting of three gears, and driven by the same shaft as the delivery pump. The function of this oil return pump is to draw the excess oil out of the crankcase and return it to the oil reservoir. One section of this pump draws oil from the sump at the propeller end of the crankcase and the other section draws oil from the sump at the distributor end of the crankcase. Both halves of the pump deliver oil to the connection on the left side of the oil pump body marked "Oil Out," from which point it returns to the oil reservoir.

Cooling System

Cooling water is circulated through the Liberty engine by means of a centrifugal pump running at one and one-half times engine speed. The capacity of this pump is 100 gal. per min. at 1,700 r.p.m. The cooling system from the pump inlet to and including the water outlet header will hold 5½ gal. of water.

The water pump is provided with a single inlet, the outside diameter of which is 2 in., and two outlets each one delivering water to a header, the two headers supplying the right and left hand cylinders respectively. Water is forced into each cylinder jacket in a tangential direction. This construction gives the water a whirling motion inside the jacket and insures uniform cooling.

The water outlet pipe for each cylinder extends inside the jacket to a point very close to the exhaust valve chamber, which assures proper cooling of the exhaust valve. The cooling water then passes through a passage cored in the intake headers. This serves to warm and further vaporise the incoming gas as well as to assist in cooling the water-



Sectioned view of Liberty engine, illustrating oil distribution. Inset: The domed piston of the high-compression model.

These passages in the intake headers are connected by two water outlet headers, the final outlet of which has an outside diameter of 2 in.

The water pump is driven from a vertical shaft which takes its drive from the same vertical shaft that drives the camshaft driveshafts and the generator. This shaft extends downward and has a bevel gear which meshes with a bevel gear on the end of the pump shaft, thus accomplishing the drive. The vertical shaft extends downward and terminates in the oil pump, carrying the driving gear of the gear type of pump utilised for this purpose.

Two duplex Zenith carburettors are used on the 12-cylinder Liberty aircraft engine. This is equivalent to four single carburettors, each one supplying three cylinders of the engine. Each duplex carburettor consists of a single float chamber and a single air inlet joined to two separate and distinct spray nozzles, venturi and idling devices. (As the V-type engine is, in a sense, two separate engines, joined together for greater utility, so the Zenith is built in double form for the purpose of supplying each one of these two engines with its exact requirements.) Each of the two barrels of each carburettor is fitted with a throttle valve of the butterfly type. The shafts of the throttles are parallel with the centerline of the engine, or "fore and aft," and are interconnected by means of gear sectors pinned to the throttle shafts and meshing together. The two pairs of throttles are operated simultaneously by a shaft, provided with an adjustment at each end by means of which the pairs may be synchronised. Each duplex carburettor is fitted with an altitude adjustment which affects both barrels equally.

Clearances Used in the Liberty Engine

	Minimum	Maximum	Desired
Crankshaft—			
Diametrical clearance	0·0025	0·00325	
End play	0·0575	0·0775	
Connecting rods—			
Forked end—			
Diametrical clearance	0·003	0·004	
End play	0·008	0·020	
Plain end—			
Diametrical clearance	0·005	0·0065	
End play	0·004	0·008	
Piston pin—			Select for ·001
Fit in rod	0·00025	0·00125	clearance
Fit in piston	0·00025	0·00075	Select for light drive fit
Piston rings—	Loose	Tight	Top 0·003; Mid. and
Fit in grooves	0·00125	0·003	Bot. 0·002
Gap	0·021	0·041	0·030
Piston—			Select for
Fit in cylinder	0·018	0·022	0·020 clearance
Camshaft—			
Diametrical clearance	0·001	0·003	
End play	0·000	0·004	Min. 0·002
Camshaft upper driveshaft—			
Diametrical clearance—			
Large bushing	0·0005	0·0025	Min. 0·0015
Small bushing	0·0005	0·0025	Min. 0·0015
End play	0·002	0·008	Min. 0·004
Rocker levers—			
Diametrical clearance	0·00025	0·00175	Min. 0·001
End play	0·005	0·010	0·0075
Valves—			
Fit of stems in guides—			
Diametrical clearance—			
Exhaust valve	0·004	0·0065	0·005
Inlet valve	0·002	0·0045	0·003
Water pump shaft—			
Diametrical clearance	0·0015	0·0035	Min. 0·0025
End play	0·006	0·010	0·010
Water pump bevel driver—			
Diametrical clearance	0·001	0·0025	
End play	0·005	0·008	
Oil pump—			
Fit of gears in housing—			Select for
Diametrical clearance	0·001	0·005	0·004 clearance
End play	0·002	0·007	Select for 0·003 clearance
Tappet gap—			
Exhaust valve	0·019	0·021	
Inlet valve	0·013	0·016	
Breaker gap	0·010	0·013	
Spark plug gap	0·015	0·015	0·015
Regulator—			
Contact gap	0·005	0·007	
Height of pin	0·043	0·045	

Restrictions on Manufacture Suspended

THE Minister of Munitions has suspended until further notice—which means in effect permanently—the Aeroplanes (Experimental Manufacture) Order, 1917, and the Aero Engines (Experimental Construction) Order, 1918, which prohibited the experimental manufacture without a licence of any aeroplane, seaplane, or part thereof, or any aero engine. Experimental manufacture meant, it will be remembered, any manufacture not under Government contract, and included even the preparation of working drawings, but not of general arrangement drawings.

The whole industry will be vastly relieved at the removal of these restrictions on its peace-time activities. Undoubtedly it was essential for the purposes of the War that experimental work of the kind indicated in the Orders should be restricted and the whole effort of the industry concentrated on war work. Now that the War is over and these reasons no longer enter into the calculation, it is satisfactory to know that the Minister of Munitions is losing no time in removing the restrictions.

Aluminium Orders Suspended

THE Ministry of Munitions has suspended the operation of the following Orders :—

The Aluminium Order, 1916, dated December 2nd, 1916.

The Aluminium (Returns) Order, 1917, dated February 17th, 1917.

The Aluminium (Scrap and Swarf) Order, 1917, dated February 28th, 1917.

The Ministry has revoked as from the 31st ult. the Refractory Materials (Maximum Prices) Order, 1918, dated November 19th, 1918.

Timber Restrictions Removed

THE Board of Trade announce that as from January 1st, no permits will be required for dealing in timber of any kind in the United Kingdom. As from the same date no permits will be required for buying, selling, or negotiating for the transport of hardwood timber, rattans, or Malacca canes outside the United Kingdom for delivery to places abroad. The Export of Timber (Ireland) Order, 1917, and the Packing Case and Lapping Board Order, 1918, are also revoked.

Mr. Bertram Jones Leaves the Air Ministry

IN view of the Armistice, and pending demobilisation and the re-organisation of the Air Ministry which must follow, the Air Council have decided that the work entrusted to Mr. Bertram Jones, of reporting on the war system of provision, maintenance and issue of stores, should be discontinued. The Council have conveyed an expression of warm appreciation to Mr. Jones for his services, and for his great assistance, in an honorary capacity, to the Air Ministry, during the last year, in connection with the organisation of a Finance Division, and thereafter with questions arising in the Department of Equipment.

More Possible Entries for the "Daily Mail" Prize

ALTHOUGH definite entries have not yet been made, three more possible competitors for their trans-Atlantic prize have been mentioned by the *Daily Mail*. One is a Curtiss "Colossus" flying-boat, which may be piloted by a U.S. Navy pilot, another is Lieut.-Col. R. Collishaw, D.S.O., a Canadian pilot, who proposes to use a five-engined Handley Page, and the third is Lieut. Pat. O'Brien, who has not disclosed what machine he proposes to use, but will have Capt. I. F. Fuller and Lieut. C. C. Robinson as his companions.

Food by Aeroplane

IN certain districts in Northern France the inhabitants are having a somewhat parlous time owing to the fact that Germans in their retreat blew up roads and railway bridges, thus preventing supplies being sent up. The French Government has now decided to utilise aeroplanes to carry the necessary provisions into the impoverished districts. French, British and American, as well as some of the German aeroplanes handed over under the Armistice agreement, will be utilised, and it is hoped that 70 tons of food will be conveyed daily.

FLIGHT

THE ROYAL AERO CLUB OF THE U.K.

OFFICIAL NOTICES TO MEMBERS.

SPECIAL COMMITTEE MEETING.

A SPECIAL Meeting of The Committee was held on Monday, December 30th, when there were present:—Brig.-Gen. Sir Capel Holden, K.C.B., F.R.S., in the Chair, Mr. Ernest C. Bucknall, Lieut.-Col. Spenser D. A. Grey, D.S.O., R.A.F., Lieut.-Col. A. M. Longmore, R.A.F., Brig.-Gen. E. M. Maitland, R.A.F., Lieut.-Col. F. K. McClean, R.A.F., Lieut.-Col. Alec Ogilvie, R.A.F., Col. C. R. Samson, D.S.O., R.A.F., and Lieut.-Com. H. E. Perrin, R.N.V.R. Secretary, in attendance.

Election of Members.—The following New Members were elected:—

Capt. Cedric Rowland Alston, R.A.F.
Lieut. Leslie Whorwood Auster (late Royal Warwickshire Regt.).
Capt. Charles Ernest Bagram, R.A.F.
Lieut. Douglas Stewart Broadhurst, R.A.F.
Lieut. William Rixon Bucknall, R.A.F.
Capt. William Arthur Kirkpatrick Dalzell, R.A.F.
George Henry Fawcus.
Capt. Robert Frater, R.A.F.
Capt. Henry Victor German, R.A.F.
Capt. William Launcelot Gordan.
Lieut.-Col. Sam Janson, R.A.F.
Lieut.-Col. Philip Henry Johnson (Tank Corps).
George Frederick Joseph.
Miss Winifred Lucas Lockyer.
Maj. Donald Woods Mason, R.A.F.
Lieut.-Col. Robert Peel Ross, R.A.F.
Lieut. Francis Blewett Shaw, R.N.V.R.
Capt. Harris Holberton Square, R.A.F.
Roland Charles Taylor.
Capt. Eric Courtenay Haden Tubb, R.A.F.
Capt. Bernard Thomson, R.A.F.
Capt. George Macfoyal Turner, R.A.F.
Lieut. Douglas Welch, R.A.F.
Capt. William Spencer Wilson, R.A.F.

FLYING SERVICES FUND COMMITTEE.

A MEETING of the Flying Services Fund Committee was held on Wednesday, December 18th, 1918, when there were present:—Lieut.-Col. T. O'B. Hubbard, R.A.F., in the Chair; Mr. Chester Fox, Lieut.-Col. H. G. Gold, R.A.F., Brig.-Gen. R. H. More, C.M.G., and Lieut.-Com. H. E. Perrin, R.N.V.R., Secretary.

Grants and Allowances.—The following Grants and Allowances were made:—

125. An allowance of £3 a month for three months to the mother of a 1st Class Air-Mechanic in the Royal Flying Corps who had been killed on active service.

127. An allowance of £4 a month for six months to the mother of a Petty Officer in the Royal Naval Air Service who had been killed on active service.

72. An allowance of £2 a month for six months to the mother of a Corporal in the Royal Air Force who had been killed on active service.

110. An allowance of £2 a month for six months to a late 2nd Class Air-Mechanic in the Royal Flying Corps who had been incapacitated on active service.

90. An allowance of £4 a month for six months to a 2nd Lieutenant, late Royal Flying Corps, who had been incapacitated on active service.

119. An allowance of £2 a month for six months to the mother of a Flight-Sergeant in the Royal Air Force who had been killed on active service.

129. An allowance of £4 a month for six months to the widow of a 2nd Class Air-Mechanic in the Royal Flying Corps who had been killed on active service.

91. An allowance of £4 a month for six months to the widow of a Sergeant in the Royal Flying Corps who had been killed on active service.

THE FLYING SERVICES FUND

(Registered under the War Charities Act, 1916)

Administered by the Royal Aero Club

For the benefit of *Officers, Non-Commissioned Officers and Men* of the ROYAL AIR FORCE who are incapacitated on Active Service, and for the Widows and Dependants of those who are killed.

Honorary Treasurer:
The Right Hon. LORD KINNAIRD.

Committee:
Lieut.-Col. HARCOURT G. GOLD, R.A.F. (*Chairman*).
Mr. CHESTER FOX.
Lieut.-Col. T. O'B. HUBBARD, M.C., R.A.F.
Lieut.-Col. C. E. MAUDE, R.A.F.
Colonel R. H. MORE, C.M.G., R.A.F.

Secretary:
Lieut.-Com. H. E. PERRIN, R.N.V.R.

Bankers:
Messrs. BARCLAYS BANK, LTD., 4, Pall Mall East, London, S.W. 1.

Subscriptions

	£.	s.	d.
Total subscriptions received to Dec. 17th, 1918	14,124	8	7
Proceeds of a Concert held at Seaford by No. 242 Squadron, Royal Air Force, Newhaven	37	1	9
South Western Area Recreational Training Association, Headquarters, South Western Area, Royal Air Force, Salisbury (Sixth donation, making a total of £790 13s. 10d.) ..	121	10	0
Total, December 31st, 1918	14,283	0	4

Offices: THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W. 1.

H. E. PERRIN, Secretary.

Back from Germany

THE following officers, who were prisoners of war in Germany, have been released, and have arrived in England:—

Sec. Lieut. G. C. Logan, R.F.C.
Lieut. W. J. M. Tomson, R.F.C.
Lieut. J. W. Toone, R. Ir. R., attd. R.F.C.
Lieut. E. V. A. Bell, Hamps. R., attd. R.F.C.
Sec. Lieut. F. H. Berry, R. Sco. Fus., attd. R.F.C.
Lieut. D. C. Birch, North'n R., attd. R.F.C.
Sec. Lieut. R. Caldecott, R.F.C.
Lieut. A. Dodds, N. Staffs. R., attd. R.F.C.
Lieut. A. G. Ryall, Durh. L.I., attd. R.F.C.
Sec. Lieut. W. A. L. Spencer, R.F.C.
Sec. Lieut. J. C. Thompson, Shrops. L.I., attd. R.F.C.
Capt. H. O. D. Wilkins, Bedf. R., attd. R.F.C.
Lieut. A. F. Wynne, Yorks L.I., attd. R.F.C.
Lieut. A. S. Bourinot, Que. R., attd. R.A.F.
Lieut. H. B. P. Boyce, Sask. R., attd. R.A.F.
Capt. A. H. M. Copeland, Can. A.S.C., attd. R.A.F.
Lieut. H. Cotton, Que. R., attd. R.A.F.
Lieut. A. C. Dean, Cent. Ont. R., attd. R.A.F.
Capt. F. R. Henry, Alta. R., attd. R.A.F.
Capt. T. G. Holley, Que. R., attd. R.A.F.
Lieut. W. B. Hutcheson, Can. Eng., attd. R.A.F.
Lieut. L. Kert, Can. Rly. Troops, attd. R.A.F.
Capt. J. R. Law, Can. A.S.C., attd. R.A.F.
Lieut. G. R. Long, Man. R., attd. R.A.F.
Lieut. W. B. MacKay, Cent. Ont. R., attd. R.A.F.
Lieut. J. P. McRae, Can. A.S.C., attd. R.A.F.
Lieut. C. Malloch, E. Ont. R., attd. R.A.F.
Lieut. D. S. Weld, W. Ont. R., attd. R.A.F.
Lieut. J. H. Wensley, Sask. R., attd. R.A.F.
Sec. Lieut. T. E. H. Birley, R.F.C.
Sec. Lieut. C. H. Clarke, R.F.C.
Capt. A. C. Hatfeild, R.F.C.
Lieut. W. B. Kellogg, R.F.C.
Sec. Lieut. G. R. T. Marsh, R.F.C.
Sec. Lieut. H. J. Sparks, M.C., K.R.R.C. and R.F.C.
Lieut. R. J. G. Stewart, R.F.C.
Lieut. W. H. Winter, R.F.C.
Lieut. H. V. Brisbin, Cent. Ont. R., attd. R.A.F.
Lieut. A. J. Cyr, Can. For. Corps, attd. R.A.F.
Lieut. C. R. Hall, Que. R., attd. R.A.F.
Lieut. R. C. Pitman, N.S.R., attd. R.A.F.
Sec. Lieut. F. G. Baker, R.F.C.
Sec. Lieut. H. P. Blake, R.F.C.
Sec. Lieut. R. S. L. Boote, R.G.A., attd. R.F.C.
Lieut. B. F. Braithwaite, R.F.C.
Sec. Lieut. H. K. Cassels, R.F.C.
Lieut. A. F. Castle, R.F.C.
Sec. Lieut. L. C. F. Clutterbuck, R.F.C.
Sec. Lieut. V. C. Coombs, R.F.C.
Lieut. F. C. Coops, R.F.C.
Lieut. E. H. Cutbill, R.F.C.

HONOURS

New Year Honours.

IT was announced in a supplement to the *London Gazette* on December 31st that the King has been pleased to give orders for the following appointments to the Most Honourable Order of the Bath, for services rendered in connection with the war :—

K.C.B. (Military Division).

Maj.-Gen. Frederick Hugh Sykes, C.M.G.
Maj.-Gen. William Sefton Brancker, A.F.C.
Maj.-Gen. John Maitland Salmond, C.M.G., C.V.O., D.S.O.

C.B. (Military Division).

Maj.-Gen. Edward Leonard Ellington, C.M.G.
Maj.-Gen. William Geoffrey Hanson Salmond, D.S.O.
Maj.-Gen. Richard Cleveland Munday, M.R.C.S., L.R.C.P.
Col. (A. Maj.-Gen.) Philip Woolcott Game, D.S.O.
Col. (A. Brig.-Gen.) Oliver Swann.
Col. (A. Brig.-Gen.) Francis Rowland Scarlett, D.S.O.
Col. (A. Brig.-Gen.) Lionel Evelyn Oswald Charlton, C.M.G., D.S.O.
Lieut.-Col. (A. Brig.-Gen.) John Glanville Hearson, D.S.O.

The King has been pleased to give directions for the following appointments to the Most Distinguished Order of Saint Michael and Saint George, in recognition of distinguished services rendered during the war :—

C.M.G.

Col. (A. Brig.-Gen.) Edward Maitland Maitland, D.S.O.
Col. (A. Brig.-Gen.) Harold Douglas Briggs.
Col. the Hon. Arthur Stopford.
Col. (A. Brig.-Gen.) Rudolph Edward Trower Hogg, C.I.E.
Col. (A. Brig.-Gen.) Hugh Caswell Tremenheere Dowding.
Col. (A. Brig.-Gen.) Eugene Louis Gerrard, D.S.O.
Lieut.-Col. (A. Brig.-Gen.) Thomas Charles Reginald Higgins.
Lieut.-Col. (A. Brig.-Gen.) Philip Lee William Herbert.
Lieut.-Col. (A. Brig.-Gen.) Cyril Louis Norton Newall.
Lieut.-Col. (A. Col.) Robert Gordon, D.S.O.
Lieut.-Col. (A. Col.) Bertie Harold Olivier Armstrong.
Lieut. Col. (A. Col.) Andrew George Board, D.S.O.
Lieut.-Col. (A. Brig.-Gen.) Felton Vesey Holt, D.S.O.
Lieut.-Col. (A. Col.) Kennedy Gerard Brooke.
Lieut.-Col. (A. Col.) Philip Bennet Joubert de la Ferte, D.S.O.
Lieut.-Col. (A. Brig.-Gen.) Norman Duckworth Keit Mac Ewen, D.S.O.
Lieut.-Col. Gerard Robert Addison Holmes, O.B.E.
Lieut.-Col. Percival Kinnear Wise, D.S.O.
Lieut.-Col. (A. Col.) Archibald Christie, D.S.O.
Lieut.-Col. (A. Col.) Arthur Wellesley Bigsworth, D.S.O.
Lieut.-Col. Evelyn Boscawen Gordon, D.S.O.
Lieut.-Col. (A. Col.) Reginald John Armes.
Lieut.-Col. Ivo Arthur Exley Edwards.
Lieut.-Col. (A. Col.) Hugh Alexander Williamson.
Lieut.-Col. (A. Brig.-Gen.) Arthur Lowthian Godman, D.S.O.
Lieut.-Col. Arthur Vere Bettington.
Lieut.-Col. (A. Brig.-Gen.) Bertram Charles Fellows.
Lieut.-Col. Geoffrey Teale Brierley, D.S.O.
Lieut.-Col. Malcolm Graham Christie, D.S.O., M.C.
Lieut.-Col. (A. Col.) Tom Dark Mackie, O.B.E.

The remainder of the New Year Honours will be published in our next issue.

Mentioned in Dispatches

IN a dispatch, dated November 8th to the Secretary of State for War, Field-Marshal Sir Douglas Haig, K.T., G.C.B., G.C.V.O., K.C.I.E., Commander-in-Chief, the British Armies in France, submits the following list of names of officers, non-commissioned officers and men serving, or who have served, under his command during the period February 25th, 1918, to midnight, September 16th-17th, 1918, whose distinguished and gallant services and devotion to duty he considers deserving of special mention.

ROYAL AIR FORCE

Staff

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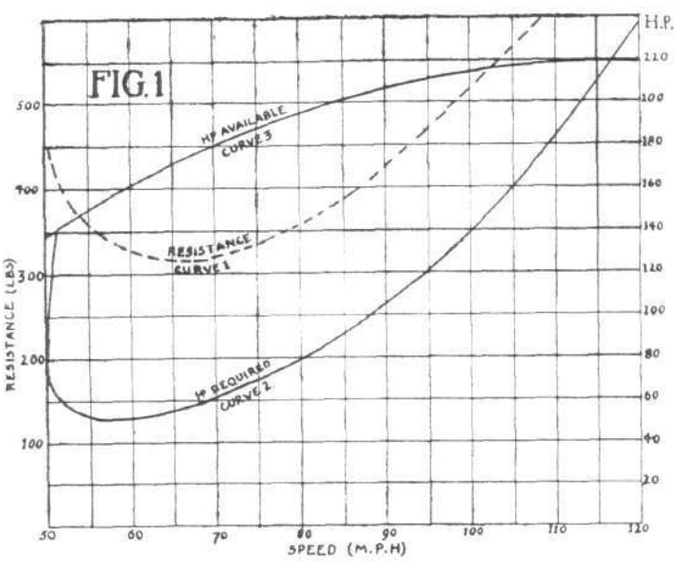
(*The remainder of the list will be given in our next issue.*)

FLIGHT

PERFORMANCE OF AEROPLANES.

By W. L. COWLEY, A.R.C.Sc., D.I.C., Wh.Sc., and H. LEVY, M.A., B.Sc., F.R.S.E.

IT is becoming increasingly evident that certain characteristics of aeroplanes are of outstanding importance in relation to fitness for fighting. Whereas in the past it was considered an achievement if machines were strong enough structurally to withstand the stresses and strains brought into play during flight and at the same time to attain a speed of 90 to 100 m.p.h., recent experience has demonstrated what important factors are excessively high speed, rapid climb, and ease and agility of manœuvre. Whether or not the engine is to play a more or a less important part than the aerodynamic parts of the machine depends upon whether such questions as durability of flight enter into the calculations. It is ultimately, however, only by an analysis of the performance curves of machines in general, and of already built machines in particular, that the more important factors upon which these questions depend can be accurately determined. The power of putting up a short spurt at a critical moment in climbing, or manœuvring rapidly in a small circle from one flight path to another, depends to a large extent on the thrust that can be developed in an emergency by the engine. The general problem of manœuvreability is clearly so wide and complicated, that it is proposed in the present article merely to analyse the performance of machines under certain steady conditions of flight, to determine the relations that exist between the horse-power that the engine and propeller develop, the rate of climb and the turning circle, and to find the conditions under which circular flight may be executed with the greatest rapidity. A corresponding analysis for spiral flight will also be given.



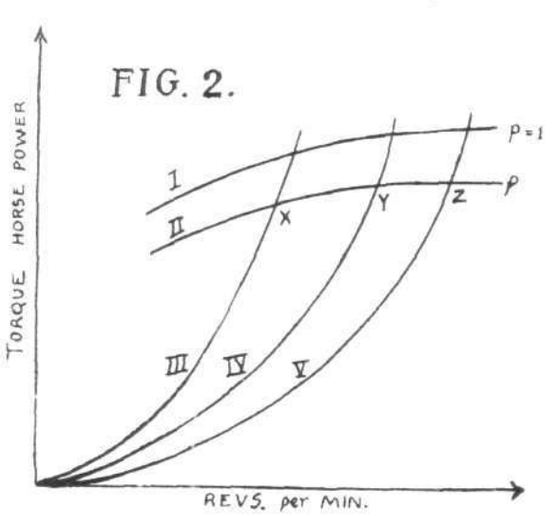
In Fig. 1 is plotted the air resistance at various speeds at ground level for a given machine. The product of each ordinate of curve 1 by the corresponding velocity gives the power required at ground level to overcome the resistance. This (curve 2) is plotted in Fig. 1 in the same diagram as the maximum horse-power available from the propeller (curve 3). The difference between the ordinates of these two horse-power curves for any speed furnishes a measure of the horse-power available for climb, &c. The upper point of intersection determines the maximum speed of horizontal flight.

Performance curves describing the characteristics of the machine at various speeds are usually plotted, as above, on the assumption that the atmosphere is of uniform density, but the fact that the air forces and the propeller thrust depend directly on the density of the air indicates clearly that the performance curves will not be complete unless allowance is made for variations in this quantity. The mere fact that at a height of 10,000 ft., a not uncommon flying altitude, the density ρ has already dropped to 0·7 of its value at the earth's surface, is a sufficiently clear indication that alterations in the performance curves due to this cause are of considerable importance.

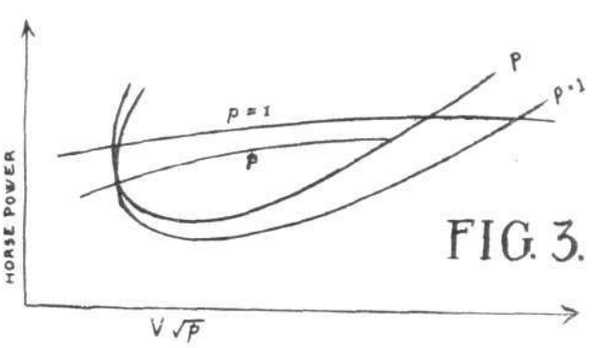
The air forces are proportional to ρV^2, and since at higher altitudes for a given angle of attack the same lift, viz., $\rho A L_c V^2$, must be maintained, a comparison between performance curves at various levels must be made at corresponding values of ρV^2. It will therefore be convenient to plot the quantities concerned on a $V\sqrt{\rho}$ base, where ρ is assumed unity at ground level. On this base the resistance curve of a machine will not change with altitude. This is not so, however, with the horse-power curves. In the case of the horse-power required to overcome the drag, the latter quantity was multiplied by the corresponding velocity. To obtain this horse-power curve, therefore, on a $V\sqrt{\rho}$ base, each original horse-power must now be divided by $\sqrt{\rho}$, so that the ordinates are accordingly all increased.

Since at the higher altitudes the velocity of flight must be increased to maintain the lift, the propeller will of necessity be working at a higher slip, and the thrust will drop unless the revolutions be increased proportionately to give the same thrust and slip. At the same time the energy given to the engine will have fallen, on account of the smaller mass of air taken up by the cylinder at each stroke for these lower densities, and therefore the horse-power delivered up will fall off for the same revolutions, approximately as the density.

In Fig. 2 is plotted horse-power available from engine at ground level against engine revolutions (curve 1). Curve 2, representing the engine horse-power at a height where the density is ρ, is derived by multiplying each ordinate of 1 by ρ. The system of curves 3, 4, and 5, giving the propeller torque horse-power against revolutions at various constant speeds, intersect curve 2 at X, Y, Z, &c., and accordingly fix the torque horse-power, forward velocity and revolutions. From these and the factors of the propeller the efficiency is, of course, at once obtained, and by multiplying the latter by the torque horse-power the thrust horse-power corresponding to that height is derived. This is now plotted on a $V\sqrt{\rho}$ base in Fig. 3. The horse-power required to drive the machine is immediately calculable and plotted in Fig. 3 on a $V\sqrt{\rho}$ base by multiplying the ordinate of the horse-power curve at ground level by $\sqrt{(1/\rho)}$.



Once more the horse-power available for further climb at each speed and the greatest minimum speed of flight can be derived. It is manifest that as the density diminishes these curves include a constantly decreasing area until ultimately a point is reached at which the maximum and minimum speeds of flight coincide, and there is no horse-power available for further climb. This determines the highest altitude to which this machine can ascend. This height is usually termed the *ceiling*. It can be further increased by special treatment of the engine—for example, by supplying it with oxygen under pressure. The effect of variation in density with height appears therefore to be the prime factor in imposing



a limit to height to which an aeroplane can ascend, and the exact manner in which this makes itself felt aerodynamically becomes clear from the foregoing simple analysis of performance. In the same manner it is proposed to consider how the horse-power expended in turning affects the performance. Suppose the machine (Fig. 4) has reached the conditions of steady horizontal flight with velocity V in a circle of radius R, the rudder and other controls having been set to the appropriate positions to maintain the steady turning. The angle of bank being ϕ the equations of motion become :—

$$L \sin \phi = W/g \cdot V^2/R \quad (1)$$
$$L \cos \phi = W \quad (2)$$
$$D = T \quad (3)$$

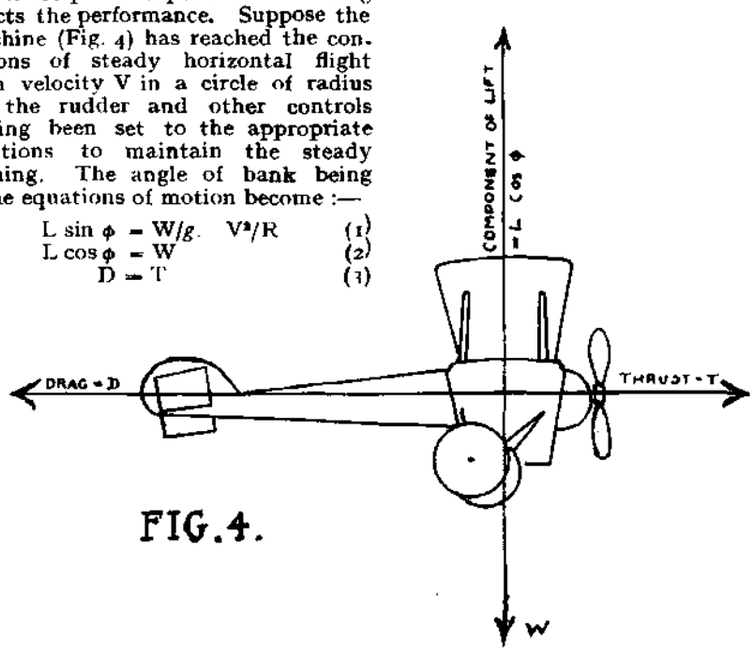


FIG. 4.

neglecting the relatively small components of the force on the rudder and the difference in lift and drag on the two wings due to the fact that the outer wing is moving more rapidly than the inner. For a given speed and flight path the requisite angle of bank is immediately given by $\tan \phi = V^2/gR$. It follows at once that to fly in a circle of small radius with a given velocity the angle of bank must be steep, but equation (2) indicates at the same time that in order that the machine will not drop the lift must be immediately augmented, demanding an increased angle of attack compared with horizontal flight. This involves a greater expenditure of horse-power.

In general performance curves for any machine usually give a measure of the horse-power required to maintain horizontal flight at various speeds. From such a curve the corresponding horse-power required to maintain circular flight may easily be derived. In either case the horse-power is expended in overcoming the drag. Comparing the two cases, horizontal flight at velocity V and circular flight at the same speed but necessarily at a different angle of attack,

$$H_1 = T_1V = D_1V = A\rho(D_c)_1V^3 \quad (4)$$

for circular flight,

$$H_2 = T_2V = D_2V = A\rho(D_c)_2V^3 \quad (5)$$

for horizontal flight, where $(D_c)_1$ and $(D_c)_2$ are the appropriate drag coefficients. Therefore

$$H_1 = H_2(D_c)_1/(D_c)_2. \quad (6)$$

Now $W = A\rho(L_c)_1V^2 \cos \phi$ from equation (2), and
$W = A\rho(L_c)_2V^2$ for horizontal flight. Therefore

$$(L_c)_1/(L_c)_2 = 1/\cos \phi. \quad (7)$$

Suppose the machine flying in straight line flight with velocity V_1 at the angle of attack corresponding to the lift coefficient $(L_c)_1$, that of the previous circular flight, then

$$W = A\rho(L_c)_1V_1^2$$

and

$$W = A\rho(L_c)_2V^2,$$

as before, where V is the horizontal flight equivalent, from this point of view to the circular flight.

Therefore $(L_c)_1/(L_c)_2 = V^2/V_1^2$

hence

$$V_1 = V\sqrt{\cos \phi} \quad (8)$$

If H'_1 and H^2 be the horse-powers required to drive the machine in horizontal flight at velocities V_1 and V respectively

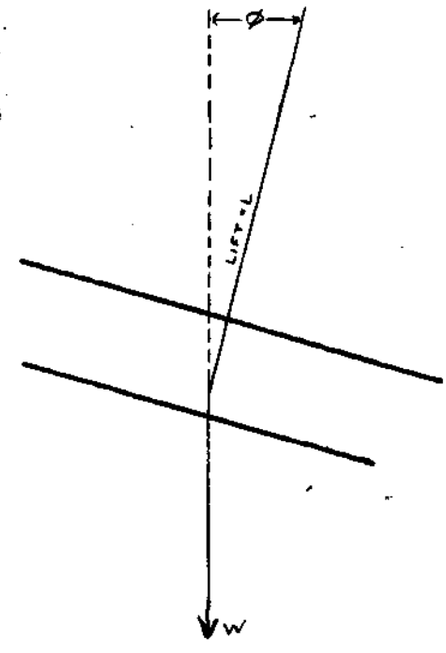
then $H_2 = D_2V = A\rho(D_c)_2V^3$,
and $H'_1 = D_1V_1 = A\rho(D_c)_1V_1^3$,
therefore $(D_c)_1/(D_c)_2 = H'_1/H_2 \cdot V^3/V_1^3$
$= H'_1/H_2 \cdot 1/(\cos \phi)^{3/2}$.

This gives finally, using (6),

$$H_1 = H'_1/(\cos \phi)^{3/2} \quad (9)$$

expressing the horse-power required to maintain the machine in horizontal circular flight, of radius R and velocity V, in terms of the horse-power required to drive the machine at the equivalent velocity of horizontal flight

$$V_1 = V \cos \phi,$$
$$= V/(1 + V^4/g^2R^2)^{1/4}. \quad (10)$$



The method of obtaining the horse-power curve for circular flight is at once obvious from these formulae. The horse-power for horizontal flight at velocity $V\sqrt{\cos \phi}$ is divided by $(\cos \phi^{3/2})$ and plotted on a velocity base at abscissa V.

In Fig. 5 AD represents the horse-power available from the propeller of a particular machine, and CB the curve giving the horse-power required at various speeds for horizontal flight. The curves of the type PQ representing the horse-power for circular flight at various radii and speeds are obtained by the method indicated above.

Since SM represents the horse-power used up during the flight, LS measures the surplus horse-power available, say, for climb.

The curve of the type PSQ, passing through L, will, except in the cases about to be mentioned, fix the minimum radius of the circle at the velocity determined by M. If CN is the locus of the points on each curve corresponding to maximum lift coefficient, none of the curves of the system can possibly go beyond CN, and the points of intersection of this system with this line determine the maximum radii of circular flight at the corresponding speeds within the range limited by C and N. The minimum possible radius corresponds to the curve touching AB, in this case approximately 180 ft.

It must be remembered that in the type of flight contemplated it is necessary that the angle of attack of the

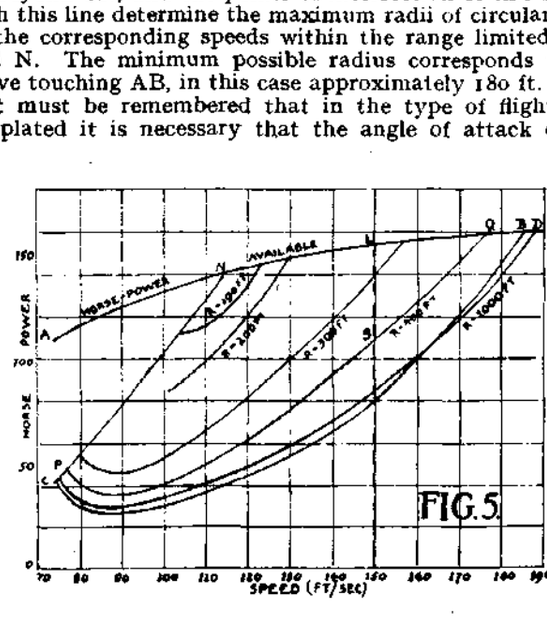


FIG. 5.

machine should correspond to a higher lift coefficient than that of horizontal flight at the same speed, in order to sustain the weight when banked. The corresponding drag coefficient would then be greater or less than that of horizontal flight, according to whether the point considered lies above or below the position of minimum drag, excluding those cases

in which the angle of minimum drag falls between them. It is evidently possible therefore to work at a higher maximum speed in circular than in horizontal flight. This is borne out in Fig. 5 by the fact that the system of "constant radii" curves ultimately cuts AD at a series of points, such as D, corresponding to a higher speed than that at B, viz., the

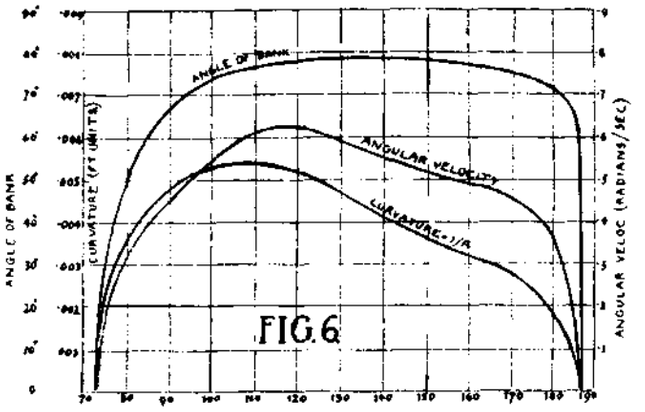


FIG. 6

maximum speed of horizontal flight. The difference is, however, comparatively small, in this case not amounting to more than 2 m.p.h.

Fig. 6 gives the maximum curvature of the path possible, the maximum angle of bank and the angular velocity for various speeds.

A rigorous treatment of the problem of circular flight would be extremely complicated owing to the introduction of certain imperfectly known factors dealing with the variation in wind forces along the wings due to the rotation.

Spiral flight.—It has just been demonstrated that circular flight without side-slipping will take place when both the rudder and banking are made use of. If the machine be supposed at the same time to drop or climb with constant velocity, the path traced out will be a helix. It is proposed to determine the relations that exist between the forces operating, and the various quantities that determine the setting of the machine when the latter is travelling with constant speed V along a vertical helix of inclination θ at each point to the horizontal, formed along the surface of a cylinder of radius r. Assume as before that the controls have been fixed in the appropriate positions so that the axis of the machine is along the flight path and neglecting the relatively small cross-wind force on the rudder. Defining the angle of bank by the inclination of the plane of symmetry to the vertical plane through the axis of the machine, and resolving forces along the tangent to the path, along the normal and binormal, Fig. 7, the equations of motion become—

$$T - D = W \sin\theta \qquad (11)$$

$$L \cos\phi = W \cos\theta \qquad (12)$$

$$L \sin\phi = W/g.\ V^2/R \qquad (13)$$

since the normal is along the radius of the cylinder and the radius of curvature of flight path $= R = r/\cos^2\theta$.

It follows that the angle of bank for a given helix defined by R and θ and for a given velocity V is determined from

$$\tan\phi = V^2/gR \cos\theta. \qquad (14)$$

From equation (12) the lift coefficient for this flight becomes

$$L_c = W/\rho A V^2 . \cos\theta/\cos\phi.$$

Writing equation (11) in the form

$$TV = DV + WV \sin\theta \qquad (15)$$

the available horse-power under these conditions may be obtained. The term $WV \sin\theta$ is at once found for various values of V and θ. Following the lines indicated in the case of circular flight, the horse-power necessary to overcome the drag at various velocities in spiral flight can be derived from the horse-power curve for horizontal flight.

Let H_1 = this horse-power during spiral flight and H_2 = the horse-power for horizontal flight at the same speed, then

$$H_1/H_2 = D_1V/D_2V = (D_c)_1/(D_c)_2.$$

Moreover $L \cos\phi = W \cos\theta.$

Hence $W = A\rho(L_c)_1 V^2 \cos\phi/\cos\theta,$

and $W = A\rho(L_c)_2 V^2$

for horizontal flight at the same speed.

Therefore $(L_c)_1/(L_c)_2 = \cos\theta/\cos\phi.$

If V_1 be the horizontal velocity corresponding to the same angle of attack as in the spiral flight, then

$$W = A\rho(L_c)_1 V_1^2,$$

therefore $V^2/V_1^2 = (L_c)_1/(L_c)_2 = \cos\theta/\cos\phi.$

so that $V_1 = V\sqrt{(\cos\phi/\cos\theta)} \qquad (16)$

Now $H_2 = D_2V = A\rho(D_c)_2 V^3.$

Let H'_1 = the horse-power required for horizontal flight at the equivalent velocity V_1, then

$$H'_1 = A\rho(D_c)_1 V_1^3,$$

therefore

$$(D_c)_1/(D_c)_2 = H'_1 V^3/H_2 V_1^3 = H'_1/H_2 . (\cos\theta/\cos\phi)^{3/2}.$$

Hence finally $H_1 = H'_1(\cos\theta/\cos\phi)^{3/2}. \qquad (17)$

Since θ is supposed given and ϕ has been determined in terms of θ, V and R, this equation provides a means of obtaining the horse-power to overcome the drag during spiral flight at velocity V in terms of the corresponding horse-power for horizontal flight at the velocity $V\sqrt{(\cos\phi/\cos\theta)}$.

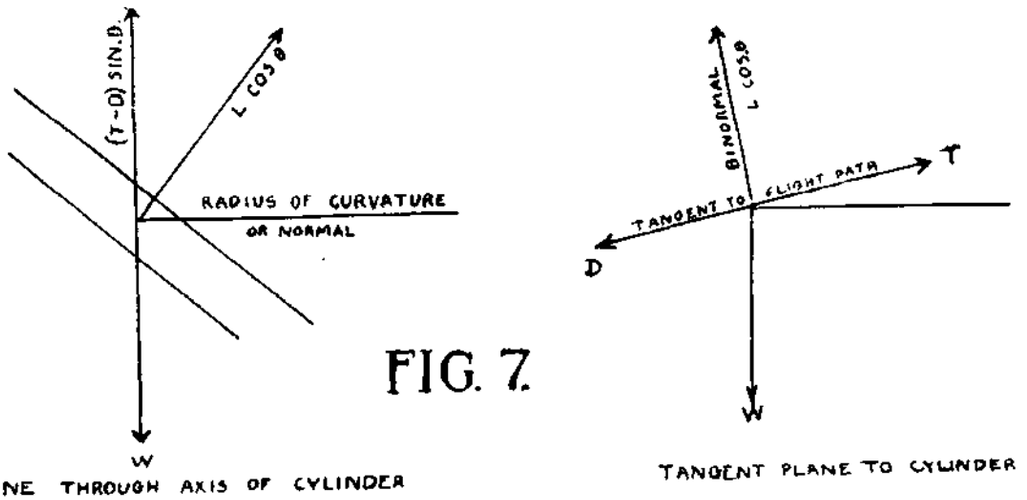


FIG. 7.

This will provide a system of curves for all values of R for each value of θ. By the same process of argument developed for circular flight, the various characteristics such as the minimum radii of curvature of flight path, are determined. It is evident that the presence of the term $WV \sin\theta$ in equation (15) corresponds to an extra expenditure of horse-power for climbing beyond that required for circular flight, so that the minimum radii of curvature for spiral climbing will be greater than that for circular flight.

The Latest Gotha

"By chance I was recently led into the great hall at Döberitz, where, now the War is over, giant Gothas lie in repose," writes the *Daily Mail* correspondent in Berlin. "I was allowed to inspect one machine of gigantic proportions. Its span of wing was 160 ft. I cannot give other details, except that it cost £50,000 to build. The machine had never been up, except in trial flights. It was just about to start a new series of raids on Paris when the armistice stopped it."

The Polish Aviation Service

WRITING from Warsaw, and dealing with the lack of equipment in the Polish armies where they are making a stand against the Bolsheviks, Mr. J. M. N. Jefferies, the *Daily Mail* correspondent, states that the Poles have 14 aeroplanes, mostly old training machines, in which machine guns and other military gear have to be haphazardly mounted as best can be done. Efforts are being made to buy some more at Vienna, 10 or so, at whatsoever price.

LORD WEIR ON THE FUTURE OF FLYING

ON December 20th, Lord Weir, Secretary of State for the Royal Air Force, visited the National Aircraft Factory (Crossley Motors, Ltd.), at Heaton Chapel, and was presented with a D.H. 9 machine subscribed for by 7,000 members of the A.I.D. In handing over the machine, Brig.-Gen. R. K. Bagnall-Wild, Controller of the A.I.D., said it was a token of appreciation of the staff's loyalty to their country, of the work done by the R.A.F. and pilots, and in token of gratitude for the way in which Lord Weir had ruled, guided and helped the A.I.D. staff.

Lord Weir said he accepted the aeroplane as a mark of the patriotism and generosity of the staff of the A.I.D., who, by their care and watchfulness, had earned the confidence of all the pilots and observers in the machines which it had been their duty to fly.

The machine was christened "A.I.D." by the Lady Mayoress of Manchester, who was then presented with a silver salver by Sir Kenneth Crossley on behalf of Crossley Motors, Ltd.

Lord Weir, accompanied by the Lord Mayor and Lady Mayoress (Alderman and Mrs. Makeague), Sir Kenneth Crossley, and the other members of the party, subsequently made a tour of the works, and saw some 300 aeroplanes in the process of construction.

Lord Weir was afterwards entertained to lunch by the Lord Mayor and Corporation of Manchester, and in responding to the toast of his health, drew attention to the growth of the R.A.F. In August, 1914, the Flying Services consisted of 285 officers and 1,853 other ranks. In November 1918, the strength of the Royal Air Force was 30,000 officers, 200,000 men, and about 30,000 women and boys. Some 15 per cent. of the flying officers in France were Canadian by origin. In the same period the number of aeroplanes and seaplanes had grown from 211 to 22,000, and against four small squadrons, we had 191 squadrons at full strength, and 60 in course of formation.

Turning to the development of aviation for civilian purposes, Lord Weir said:

"Any adequate survey of the future of civilisation must involve an enquiry into the future of transport. For transport is that which welds civilisation together, and its function in human progress is extremely important. We have hitherto had transport by land and transport by water, and to-day we have, in actual practice, transport by air. It may well be—but I am not here as a prophet—that the new mode of transport will one day rival, and even surpass, the other two. At any rate, the compelling influence of a very grave national danger has resulted in an intensive development of aviation, which when compared with the development of any other scientific and economic factor in our lives, seems not only astounding, but somehow artificial. Nevertheless, it has been a real development. The thing exists; and the problem before us is the problem of transforming that which has exclusively served the ends of frightfulness into an organism which will serve in the completest way the infinitely more valuable ends of peace.

"I want to-day to visualise for you, if I can, the method and the extent to which a nation inheriting from the War a legacy of aerial experience fuller, perhaps, than that of any other nation, can reinvest and adopt that inheritance for the bettering of mankind. Let me give you one little indication of the progress we have achieved in the mere mechanics of aviation. And let me admit that even those of us who live in the heart of this great business have scarcely grasped the significance of the prodigious strides made during the later months of the War. I will offer you just a single fact. We now possess aeroplanes which carry a crew of seven and passengers to the number of 30, which climb to a height of 10,000 ft., which travel at a speed of 100 miles an hour, and which can make a journey of 1,200 miles without a stop. We possess such machines for travel over land, and similar machines which, if necessary, can come down on the surface of the seas, float, and rise again with their full load. We have designed and constructed these machines; we have tested and tried them in every way; and, either actually delivered or under construction, we possess them in substantial numbers. So much for the mechanical or constructional side of aviation.

"But aviation must be viewed in two aspects—the constructional aspect and the operational aspect. There is the technique of the material, and there is the technique of the use of the material. It is not enough to make machines which are marvels. We must be able to navigate the machines and organise that navigation, to the last limit of the possibilities of the machines. This is what I call the operational aspect; and I have to say with the strongest emphasis that there has been, and still is, a serious danger of it being overlooked, or at all events slighted, in favour of the constructional or manufacturing aspect. There is a serious danger that the adventurous and sometimes rather reckless commercial enterprise of the air industry may result in disappointments, unless the operational side of aviation is kept prominently in view. I perceive no immediate limitation on the constructional side; but I do perceive limitations on the operational side.

"The technique of flying and the organisation of air transport still demand long study and many experiments for their perfecting. True, wondrous 'stunts'—I feared that I might succumb to that popular word, and I have done so (laughter)—wondrous 'stunts' are performed in the air, and these 'stunts' have been immediately useful in the art of war, and they will continue to be useful for the testing of machines. But gymnastics and acrobatics in the firmament have really little to do with the operational side of aviation. The air traveller of the future will have no desire to take part in a circus. He will want to be sure that on a given day, to be settled in advance, he can leave, say, London at a certain hour in the morning and arrive, say, at Marseilles at a certain hour in the afternoon, whatever the weather.

"I am an enthusiastic optimist about the future of aviation, but I hope my optimism is sane—may I divulge the fact that I come from Glasgow?—I say I hope my optimism is sane, and therefore I shall venture to insist that at this highly critical period in the history of the new transport nothing but harm can come from not facing the facts; and I will add my opinion that the future may be gravely prejudiced by impatience for showy results. The success of the operational side of air transport will depend upon measures which cannot be carried out in five minutes. These measures are:—The development of the navigational instruction by really sound and severe navigational training, the creation of an energetic meteorological service specially designed to help air transport, the adoption of improved systems of wireless telegraphy and telephony, and the adoption of a first-class system of day and night marking of landing-places and aerodromes. If these measures are taken, I am quite clear that five years hence there will be no more difficulty in navigating an aeroplane over a long course in foggy or otherwise bad weather than there is now in navigating a ship. If these measures are not taken, if hard and continuous experimental study is not put into the problems yet unsolved, then trouble, delay, and discouragement will certainly ensue. I am happy to say that already we have machines so devised that they can land safely at definite gliding angles entirely without human control. This means that, when the pilot can set his instruments by means of a kite balloon anchored in clear air, he will be able to land with safety in an aerodrome completely fogbound.

"Having stated certain general aspects of the matter, I now come to the question: What part is the State to play in the developments which I have foreshadowed? This question, I am well aware, is as prickly as a hedgehog. There is only one satisfactory way of handling hedgehogs—and that is, to seize them with a peculiar light firmness. If you are in two minds about the prickles of a hedgehog, you are lost. I therefore seize this particular hedgehog with a peculiar light firmness. It has been argued that, since the whole of aviation is actually in the hands of the State, the State can start fair and run the whole of aviation in the future as a Government monopoly, just as it runs the Post Office, and as—I hear from Dundee—it will shortly run the railways.

"Well, I have had considerable experience of private enterprise, and I have had a shorter but far more exciting experience of Government enterprise. Both, in my opinion, decidedly have points. But I do not think that the best ends of civilisation will be served by keeping civil aviation for a Government monopoly. I am convinced that co-operation between the activities of the State and the activities of the private firms will produce the finest results. The State must be the pioneer—it must help, it must encourage, it must guide, it must exercise control, it must be in a position to say 'Thou shalt' and 'Thou shalt not'—but emphatically it must not monopolise. And I am sanguine enough to conceive a Government Department which will be, not an autocrat, but an elder brother to both the constructional and the operational sides of aviation.

"I will tell you one or two things about such a Department. It must be in the charge of few men, but of the best available men; and they must be highly paid. It must be in the charge of men who are accustomed to wait patiently for results, not of men who want to be in the middle of next

week before they have got over Sunday. It must be broad-minded enough to engage the interest and enthusiasm of the biggest people for the biggest schemes. For example—and solely by way of illustration—I would like to see the big shipping and other existing transport organisations actively interesting themselves in the development. Such a Department must strive to acquire the best qualities of a private business, and, in a word, it must function as far as possible like a private business, for a public end. It would, perhaps, be alien to our grand bureaucratic traditions, but I should not mind that, for I think it would represent the new spirit which, as a result of war experience, is coming over this country. The new Department should, of course, spring out of the existing Air Ministry, which must be reconstituted and reorganised, so as not only to control the administration of the Royal Air Force, but to act as the supreme authority for the development of civil aviation.

"The first essential step of the new Ministry should be to organise international flying—flying between different countries. This will involve an international aircraft convention. I may say that we have already drafted the articles of this Convention, which is being submitted to our Allies. If they substantially approve it, an international air conference will be held; and I have reason to anticipate that within the next four or five months the principal nations of the world will have reached agreement on this momentous matter

"Similarly, domestic legislation will have to be passed for the regulation of flying in this country. The draft Bill is now ready, and I anticipate that within a few weeks of the opening of the new Parliament a useful Act will come into force.

"It will be appreciated that until this Convention and this domestic legislation become operative there can be no private flying at all, either international or in this country. In many parts of the Continent a state of war still exists: and, moreover, even if a state of war did not exist, I should oppose any private flying until suitable legislation was passed. It would, indeed, be unfortunate if the development of civil aviation was retarded owing to the effect of a series of fatal accidents due to a lack of absolutely necessary regulations. Eager aviators may chafe under the delay, but I would remind them that, legislation or no legislation, the weather of this unique island is apt to be so variegated, violent, and undependable that during the next three months serious flying for transport purposes would anyhow be impossible with our present imperfect navigational arrangements.

"As a part of the help, encouragement, and guidance which I mentioned a moment ago the new Department will have to provide a thoroughly efficient technical section for research and experimental purposes, which section would work in closest touch with private industry. Substantial public expenditure would be necessary for the opening up of new avenues of progress and for the development of what is proved to be good in private enterprise. Further, the State should acquire in permanence a large proportion of the existing military aerodromes, and should render them available for general use by leasing sheds to private operational companies and merely charging a fee for landing. In this way, while the State would not suffer, private enterprise would be relieved of an exceedingly heavy capital charge.

"The Department should undertake the training of all pilots to be employed on public transport services, whether such services are in the hands of the Department itself or in private hands. Such a course would fulfil two purposes. It would secure public confidence in the efficiency of the pilots, and it would provide a reserve of pilots for the Royal Air Force in times of emergency. From the superabundance of machines at its disposal upon the conclusion of peace, suitable for conversion to commercial use, the State should be ready to dispose of a considerable number at a low price to private operational companies. The new Department should undertake the mapping out and the marking of aerial routes, the lighting of the same by day and by night, and the inspection and certification of all private aircraft. And, above all, it should attend to the special meteorological developments which I have already mentioned. Finally, the new Department must be ready itself to undertake mails, goods, and passenger services wherever private enterprise may be found lacking.

"I have merely outlined, in a manner necessarily somewhat vague, the main contours of the vast subject upon which I have ventured to address you, and I cannot on this occasion do more. I will add just a word about a point which is doubtless in the acute and active mind of every business man here—finance! The scheme which I have indicated will cost money—a lot of money, according to pre-War standards, but a very little according to the standards of war. And however much it costs, it will not be expensive, for it will serve two ends, of which the value is beyond money. First, it will provide this country with a new and tremendous industry, which, in a supreme degree, will constitute and maintain the arterial system of the great civilisation of the future; and, secondly, it will do honour to, consummate, and justify the magnificent work begun by those who are dead, and whom we mourn. It is not given to me to use fine phrases, and Britons are not accustomed to express their deepest feelings with much eloquence, but I must point out to you that our present achievement in the air, and all our further achievement, has been, and will be, built upon sacrifices, upon martyrdoms, upon sudden and violent deaths, upon incalculable devotions, not only beyond the seas, but here at home. We owe the profoundest loyalty to those who are gone, and, when we plan for the years ahead, let us not forget to be worthy of them."

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Aerial Escort for President Wilson

As in the case of other distinguished visitors who have recently crossed the channel, President Wilson on December 26th was provided with an aerial escort. A squadron of French machines convoyed the mail steamer "Brighton" until mid-channel was reached, when a formation of 14 British aeroplanes relieved them. Lord Weir was among those at Charing Cross to greet the President, and detachments of the R.A.F. and W.R.A.F. were posted along the route of the procession at Constitution Hill.

Cape-Cairo Air Route

IT is announced that the Air Ministry has despatched to Central Africa two parties with machines and equipment to prospect and survey an aerial route from Cairo to Cape Town. The possibility of a flying route from India to Australia *via* Singapore is also being investigated.

Military Division of the O.B.E.

THE King has been graciously pleased to institute a Military Division of the Most Excellent Order of the British Empire, to date from the creation of the Order, June 4th, 1917. All commissioned and warrant officers recommended by the G.O.C. Independent Force, R.A.F., or employed under the Air Ministry and members of the W.R.A.F. are eligible for the new division. Those who are already appointed to the Order and who are qualified for the Military Division may, on the recommendation of the Secretary of State for the Royal Air Force, be transferred to the Military Division.

The insignia for both Military and Civil Divisions will be the same, but the ribbon of the Military Division will be distinguished by a vertical red stripe in the centre of the existing ribbon.

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Aerial Services for Prince Edward Island

AT a meeting of business men recently held at Charlottetown, Prince Edward Island, it was resolved to organise a company to establish a flying service between the island and the mainland. It is suggested that the first route should be *via* Moncton, Summerside, Charlottetown, Georgetown, Picton, New Glasgow, and Halifax, and it is planned to have a double daily service, summer and winter, to handle mail and express matter.

The Ipswich to India Flight

IT was announced on December 24th that the Handley-Page machine, H.M.A. "Carthusian," piloted by Major A. S. MacLaren, M.C., with General MacEwan as one of the passengers, had arrived safely in Egypt. The machine flew by way of Sicily and Malta, stopping a night at each island. Leaving Malta at 2 a.m. on December 20th the machine passed over Bengazi and Sollum, landing, for engine adjustment, at Mersa Matruh, on the African coast at noon. Owing to rain, which flooded the machine, it was impossible to continue, and General MacEwan and the other passengers went on to Cairo by train.

The Cairo to Calcutta Flight

A FEW more particulars are now available regarding the flight of Maj.-Gen. W. H. Salmond, D.S.O., from Cairo to Calcutta in a Handley Page machine piloted by Capt. Ross-Smith, A.F.C. The longest single flight was from Damascus to Baghdad, a distance of 495 miles, which occupied 6 hours 53 mins., while the next longest stage, from Karachi to Nasirabad, 485 miles, took 6 hours 35 mins. During the journey from Damascus to Mesopotamia the machine carried food supplies for seven days, and the General had a letter signed by Sherif Feisul, son of the King of Hedjaz, asking the Arabs to tender any assistance required.

AIRISMS FROM THE FOUR WINDS.

QUITE a number of greetings for the season has reached us from various R.A.F. squadrons, and one of the happiest, which we reproduce, carrying with it up-to-dateness, comes with the best wishes of the officers of 213 Squadron R.A.F., Flanders, the legend accompanying R. Graham's clever picture being—

"He's crashed for good, so here's for—
A Merry Christmas and a Happy New Year, 1918-1919."

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AND so say all of us, with hearty reciprocity.

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LOOKS as if when the next war *does* arrive war in the air is likely to be catered for from a variety of sources. From Salt Lake City Mr. John M. Browning—good name to be connected with shooting-irons—announces "the perfection of a combination of three machine-guns on an aeroplane mount, enabling the flyer to fire 3,500 shots a minute, by pressing one trigger." Some shoot! A few equipments like this should make it pretty unhealthy for the quarry when hunting by aeroplane becomes the vogue.

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HUN aeroplanes appear like advancing in price. A message from Copenhagen states that the Workmen's and Soldiers' Councils are offering 4,000 German aeroplanes for sale at about £111 apiece, stimulating buyers by promising a generous supply of benzol. Looks as if our Armistice terms, in claiming only 2,000 planes, somehow missed the mark. The Peace conspirators should look into this little lot of Hun machines agoing begging.

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OUR auto constructors who are puzzling their heads to evolve a cheap light motor car that will attract prospective purchasers who may be hesitating between car and plane in the near future, had better get on with their output, ere it is too late. According to our French contemporary, *l'Auto*, "a French aeroplane constructor has invented a new type of machine which will not cost more than a small motor car, and of which the speed will be 100 miles an hour. The machine, it is added, is very light, and can be taken to pieces in a few moments." All the same the day of the quick-assembly plane is hardly yet, whatever the far future may bring with it. We have a hazy recollection of hustle in the past in aeroplane building, where the designer started to design at 6 a.m. one day, had his working drawings out by 10h. 33m. 17 sec. the same morning, was finishing the body by——, but that is another story. The executors never sent us the details of how she didn't fly.

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THE Aero Club of Belgium, wishing to confer a merited honour on their airmen during the war, has decided to present to all, pilots and observers alike, a diploma. Metal plaques will be given to men mentioned for distinguished service and the first gold plaque has already been awarded to Capt. Willy Coppens, the first Belgian "ace."

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AN aerial postal service is among the measures of reconstruction contemplated by the Belgian authorities. It is hoped that a Brussels-Liège and Brussels-Bruges mail may be inaugurated soon, to run daily from the Evers Aerodrome. At the outset this will be confined to official mail, but it may be extended to become a permanent institution.

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A MONUMENT is to be erected in the near future in a Brussels square to the memory of Belgian aviators who have given their lives for their country. So far, a definite site has not been decided upon, but the great Belgian sculptor, Rombaux, has been asked to proceed with the monument.

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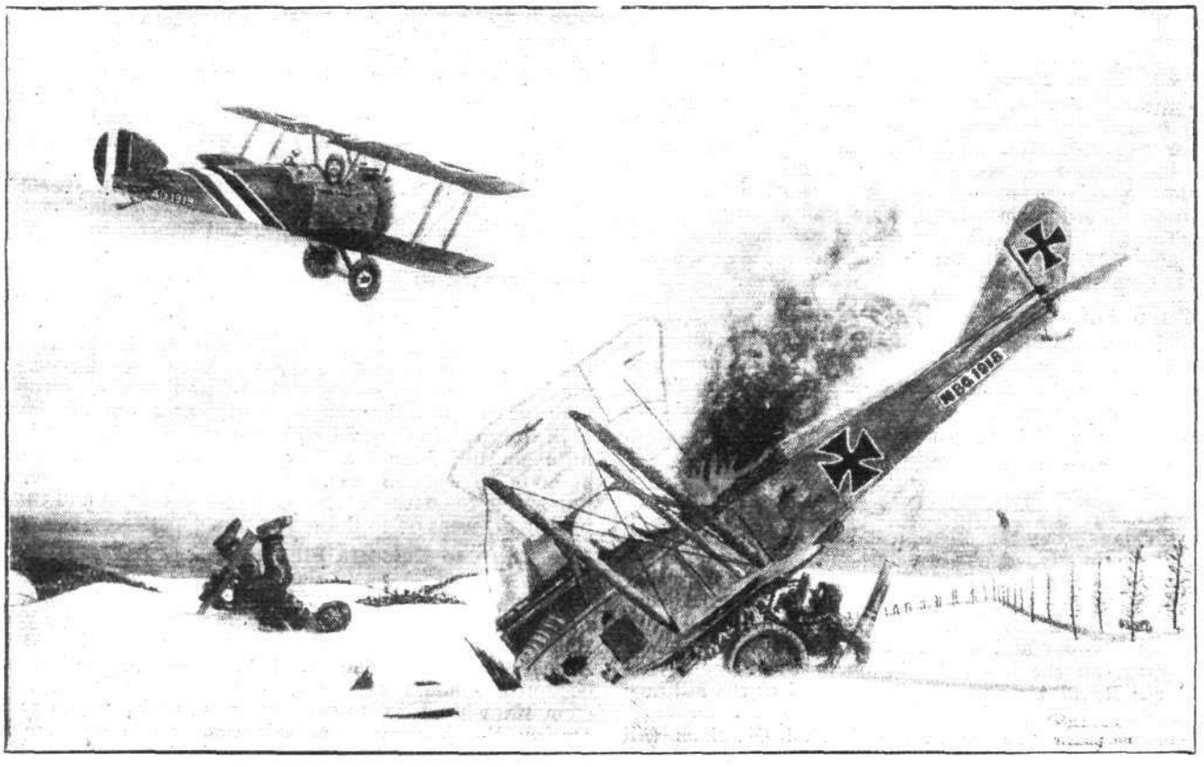
POSTAL services from Naples to Rome, which have recently been inaugurated under the aegis of the military authorities, are now running regularly and without a hitch. The saving in transit is said to be such that in all probability this aerial line will be continued under civil management.



The Christmas and New Year's greeting card from the officers of 213 Squadron R.A.F., Flanders.

A PARIS contemporary gives an interesting interview with Lieut.-Col. Piccio, of the Italian aviation service, in the course of which the following interesting notes on Gabriele d'Annunzio occur :—

"I knew him well. He was an admirable man, and might be said to have been the soul of our war. In the dark hours of the Piave, our Verdun, at the moment when Italy was living through the most tragic hours, d'Annunzio went to the trenches and exhorted our men. He spoke to them of the greatness of Italy, of the sacred mission incumbent on them. He spoke of the provinces awaiting deliverance—in a word he electrified the men. And he produced the miracle of an army suddenly enthusiastic once more, reborn to hope, revived by the words of one man, the immortal and divine germs of victory.

"Yes, I admire d'Annunzio profoundly. I love in him the poet, the soldier, the man of action, and the born leader of men. I salute in him the leader of our aerial army, of our landsmen, of our sailors."

In response to a query as to whether the great Italian was actually a pilot, as has been stated Lieut.-Col. Piccio said :—

"D'Annunzio was an observer. One of his sons, a talented engineer, took his ticket, and was thought very highly of by Caproni. D'Annunzio is a knight of the air, he could have bombarded Vienna, but he preferred to make the magnificent gesture of exposing his precious life throwing to the famished Austrians proclamations preaching wisdom, and exhorting them to demand peace, that they might live. He has always held his life cheaply, and sought danger—his innumerable nocturnal journeys over land and sea are so many proofs of his intrepidity."

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IN the course of a recent trial in France of an automatic stabiliser, the pilot, Moreau, folded his arms, allowing the machine to land itself. This invention is being developed with a view to its ultimate employment in commercial aviation.

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A propos a paragraph on page 1229 of "FLIGHT" for October 31 last, we have until now overlooked a letter from Mr. S. F. Edge in which he asked a rather pertinent question concerning the airmen's work in harassing the German retreat over the Vesle. To refresh the reader's memory, our paragraph read : "The order went forth that the bridge by which the Huns were crossing must be destroyed 'at all costs.' Up went a British pilot, but when he got into bombing position he was shot down. Another followed, only to share the fate of the first. Machine after machine went up, but one after another came crashing to the ground The Huns had posted two 12-inch howitzers, the shells from which converged to a point immediately above the bridge, and no pilot flying low enough to make sure of his mark could escape the area of tremendous concussion caused by the explosions. Still, the attack on the bridge was maintained without a falter, a pile of crashed machines meanwhile accumulating on the river banks, until at length the bombs found their mark and the deed was done. But at what a cost ! Incredible though it may appear, more than 30 machines had been brought down by the howitzers before the bridge was destroyed." What Mr. Edge wanted to know was why our commanders did not send over our 'planes three or four in a flight, in quick succession, so that at least one of them would arrive in between the howitzers' explosions ?

Mr. Edge says : "I can appreciate that it is much easier to see a course of action, sitting on the stoop of my house, with the South Downs smiling at me, than in the middle of the noise, excitement and danger of actual fighting ; but there would seem to be good reason for supposing that three or four overlapping flights of four machines would have done the work just as surely as a slow, deliberate, one-by-one series of 30. There is no gainsaying the splendid devotion to duty which you mention, but how tragic it is that such pluck, such nerve, and so much material should have been thrown away ! I suppose it is all a part of inevitable war-wastage—but that is merely another evidence of the idiocy of war altogether.

"Now that the fighting is over, the belligerents have to sit down around a table and say 'Well, how are we going to arrange it all ? Who is to have what ? '—something which might just as well have been talked out in July, 1914. That we could sit down, or lie down, and take a licking, I do not suggest for a moment. What hurts me is that 2,000 years' civilisation should find us reduced to hiding in holes and throwing stones one at another, like a lot of cavemen, instead of bringing to bear on any quarrels a collective intelligence, expressed by three or four able representatives of each of the nations concerned. That one princeling's assassination, regrettable as it must be considered, was a poor excuse for letting slip the dogs of war, and so allowing ten million lives to be wasted before the world had sobered sufficiently to say 'Now we have made enough mess ; how shall we clear it up ? ' That is what we are saying, now, reduced to simple terms, and that is what the belligerents will *always* have to say, after wars even more devastating than this. If, as students of history and social economy tell one, war is inevitable, will always be, is there any purpose or sense in doing anything but reverting to cavemen ideas and modes of living ? "

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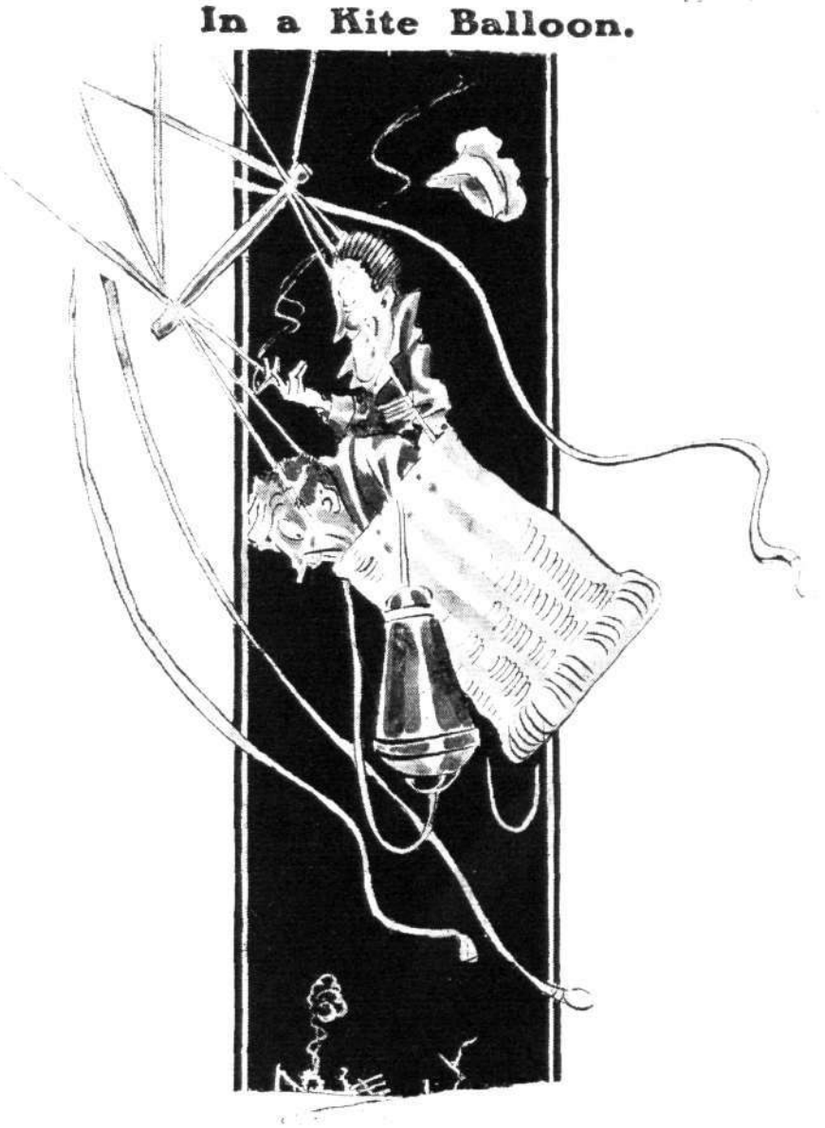
IN the course of an interview recently, M. Saulnier gave it as his opinion that the transit of the Atlantic was impossible so long as petrol was the propelling medium, owing to the factor of weight. He went so far as to say that the flight was utterly impracticable until a lighter spirit could be found.

In a Kite Balloon.



Ground lubber (up for the first time on "joy-ride") : "A-and if the Boche fires you, y-you jump out. I-I'd s-s-sooner b-b-burn."

MEDICAL NOTES

THE FUTURE OF AERONAUTICS, WITH SPECIAL REFERENCE TO THE MEDICAL EXAMINATION OF COMMERCIAL PILOTS

By Captain T. S. RIPPON, R.A.F. Medical Service

A STUDY of the question of aviation in the future leads to the conclusion that there are several types of pilots likely to be found.

1. *The pilot in charge of a passenger-carrying aeroplane.*—This is the first type to be considered. There may be a distinction drawn between the man who does short distances (London to Liverpool or Paris) and the long-distance pilot (Transatlantic and Trans-continental).

The late Capt. Hucks made the following statement to me in 1917. "In my opinion the strain on a pilot doing regular trips on a Handley Page between London and Liverpool would be no greater than that of the captain of an Atlantic liner or the driver of a motor 'bus."

This statement, with slight qualifications, has been agreed to by many experienced pilots with whom I have discussed the question.

Given a series of landing grounds, a wireless telephone informing the pilot of the weather conditions *en route*, and a reliable machine, an experienced pilot should last almost indefinitely in work of this nature.

Long-distance flying is, of course, more strenuous, but there will be usually two pilots who will relieve each other and share the responsibility.

2. *Pilots of fast freight and mail carrying aeroplanes.*
3. *Instructors at schools of flying.*
4. *Sportsmen and exhibition pilots.*
5. *Test pilots.*
6. *Aerial police.*

Crashes

This is the most important point from the standpoint of the commercial aircraft firms. No firm can stand the expense of losing continuously big aeroplanes, therefore they must insure against accidents.

Insurance

No insurance firm will underwrite a machine without knowing the qualifications of the pilot who is going to fly that particular machine as regards his flying ability and physical fitness.

Flying ability

A system of grading by the Royal Air Force or the Royal Aero Club according to ability should satisfy the public on this point.

Physical fitness of the pilot

This is the problem which must be dealt with efficiently if commercial aviation is to be a success.

The solution of the difficulty can only be made with the assistance of the State and by co-operation between the medical profession, the Universities, and the R.A.F. Medical Service. Steps should be taken that the knowledge gained by the study of so-called "Air Sickness" and the researches of the Air Medical Investigation Committee, and similar bodies in Allied countries, should be communicated to the medical profession.

A school for the study of air disabilities could be founded at one of the R.A.F. hospitals where medical students and doctors could take a special course, and the medical squadron, which is doing research work could co-operate with advantage here, in addition to increasing our knowledge of such disabilities.

The Medical Examination

The question of the sources from which our commercial aviators will be drawn and the special points to be noted require consideration.

Pilots now serving with the R.A.F.

(*a*) *Those who have served overseas.*—These must be tested to ascertain whether they are suffering from the effects of stress of active service, concussion, the effects of flying at high altitudes, or other causes which result in some cases in loss of consciousness whilst flying.

(*b*) *Pilots serving at home.*—These we would expect to be free from symptoms unless they had concussion, loss of confidence, or staleness.

(*c*) *Fresh candidates at the flying schools* require careful scrutiny in order to obtain the maximum degree of "air efficiency."

The methods of examination of pilots and candidates as carried out by the R.A.F. Medical Service

Briefly stated, the candidate is examined by a series of doctors, who are specialists, and the final reports are adjudicated by an assessor. From the standpoint of the pilot of a passenger-carrying aeroplane the following scheme, in addition to a good previous medical history, would be necessary :—

Physical Examination

Respiratory system.—In addition to being free from disease must be able to stand heights.

Circulatory system.—Must be able to adapt itself to changing atmospheric pressure, and the circulation in the extremities must be in good order to stand cold.

Nervous system.—Must re-act rapidly to all impressions received by the senses, all of which must be normal.

Muscular, cutaneous and joint sensation must be particularly efficient. For vision, special tests are necessary for pilots on account of the necessity of estimating distance and position of the aeroplane in the air. Hearing, also, for obvious reasons, must be normal.

Psychological examination.—Reliability, alertness, self-control, whether confident and mentally normal, or suffering from any symptoms suggesting an anxiety state or psychopathic condition.

Periodical overhaul.—Pilots of passenger-carrying aeroplanes should be also re-examined periodically to find out how they are wearing. In this way the tendency to accidents through staleness will be mitigated.

Aptitude for flying.—My observations show that the best aviators are not possessed of any special faculty which enables them to fly, but rather that the average normal young man with an aptitude for sport and games, and without any weak points, is the most likely to last well. The essential qualification of the best pilot, therefore, is that he should have no weak spot. Since the human organism, being very complicated, and our knowledge of the way in which it re-acts to flying, is still very incomplete, it is all the more necessary during the early days of commercial aeronautics to overhaul very carefully the mechanism of the aviator who assumes any serious responsibility.

An Aviation Section for the New York Police

THE New York Police Department has now a special aviation section, of which Col. J. DeMont Thompson has been appointed chief by Police Commissioner Richard Enright. Reasons for this appointment have been announced as follows :—

"The fundamental importance of the Aviation Section is quickly appreciated when the many duties of the Police Department are considered. The work of the aviators in connection with directing the protection of communities surrounding Morgan, New Jersey, during the recent catastrophe, when the fire threatened to set on fire tons of T.N.T., which might have caused the destruction of the subways and buildings even in New York City, emphasised the necessity of having aviators available for such emergencies.

"The work of policing the rivers, harbour and bay is also of tremendous importance, and the problems connected with this work will be easily solved by the employment of aircraft."

An American Seaplane Record

SOME further details are now available regarding the record flight of a U.S. Navy seaplane with 50 passengers at Rockaway on November 27th. The machine was an N.C.1, designed and built by the Curtiss Engineering Corporation at Garden City, and was piloted by Lieut. E. H. McCullough, U.S. Naval Reserve Flying Corps. The machine is of the flying boat type, the wings having a span of 126 ft., and it is fitted with three low-compression Liberty engines, each of 385 h.p. The normal speed of the machine is 80 m.p.h., but with 50 passengers on board this was reduced to 72 m.p.h. According to the report of the Aero Club of America, the machine left the water within 1,000 ft. at a speed of 45 knots, and rose to a height of 35 ft. It is stated that the machine can climb 2,000 ft. in 10 min.

FLIGHT

THE ROLL OF HONOUR

(When an Officer is seconded from the Army his unit is shown in brackets.)

Published December 21st

Died

Brodie, Capt. P. W.
Charles, Lieut. B. S.
Hinsley, Lieut. W.
Solomon, Lieut. H. M.

Cadets Killed

Henderson, W. D.
Lloyd, A. E.
Peddie, J. W.
Radnor, A.
Rice, E. J.

Repatriated

Brown, Lieut. E. M.
Flintoft, Lieut. H. T.
Usher-Somers, Lieut. C. E.
Toone, Lieut. J. W.

Published December 23rd

Previously Missing, now reported Killed

Mill, Sec. Lieut. J.

Died

Edridge-Green, Lieut. H. A.
Dick, Lieut. C. W.
Drake, Lieut. E. F.
McNay, Sec. Lieut. F. H.

Died of Injuries

Sampson, Lieut. W. J.

Repatriated

Fricker, Lieut. A. J.
Lynn, Lieut. F.
MacLean, Sec. Lieut. M.
Murray, Sec. Lieut. R. B.
Stringer, Sec. Lieut. J. S.

Published December 27th

Killed

Wheeler, Sec. Lieut. G. R.
Wicks, Sec. Lieut. W. D.

Died

Lindsay, Lieut. R. E.
Newbigging, Lieut. J. P.
Walsh, Lieut. L.

Died of Injuries

Edwards, Capt. S. T.

Wounded

Hughes, Lieut. J. S.

Repatriated

Evans, Maj. A. J., M.C.

Published December 28th

Killed

Owen, Lieut. S. S.
Thompson, Sec. Lieut. R. H.

Previously Missing, now reported Killed

Morton, Sec. Lieut. G. M. G.

Accidentally Killed

Owen, Lieut. S. S. (Brit. Col.).

Died

Court, Sec. Lieut. L. S.
Woollett, Capt. J. C.

Repatriated

Aird, Capt. H. R.
Alcock, Capt. J. W., D.S.C.
Baillon, Sec. Lieut. E. N.
Begg, Lieut. M. G.
Bott, Capt. A. J.
Bronson, Capt. C. G.
Burns, Lieut. H.
Bysshe, Lieut. G. T.
Clark, Lieut. C. G.
Clemson, Capt. A. W.
Cobbold, Lieut. F. R. C.
Dacre, Capt. G. B.
Gore, Lieut. F. D. C.
Greensmith, Capt. R. E.

Published December 30th

Killed

Arbuthnot, Lieut. G. R.
Ritchie, Lieut. G. T.

Died

Hosking, Capt. F. J.
Manders, Capt. S. G.

Died of Injuries

Rumsey, Capt. R. E.

Repatriated

Hill, Lieut. C. W.
Johnston, Sec. Lieut. W. A.
Logan, Sec. Lieut. G. C.
Lynn, Lieut. F.
MacRae, Lieut. J. D. G.
Mills, Lieut. A. S.
Newton, Lieut. E. A.
Paul, Capt. R. J.

Published December 31st

Killed

Reynolds, Sec. Lieut. E. F.

Died

Royston, Lieut. N.
Seed, Lieut. W. E.
Stuart, Sec. Lieut. T. C.
Towers, Capt. W. C. C.

Died of Wounds

Sloss, Sec. Lieut. J. D.

Repatriated

Pettit, Capt. S. L.
Piper, Capt. T. H.
Reilly, Maj. H. L., D.S.O.
Spratt, Capt. N. C.
Taylor, Lieut. W.
Tomson, Lieut. W. J. M.
Trechmann, Capt. B. A.
Trulock, Lieut. J. C.
Pakenham-Walsh, Lieut. L. H

The General Election

THE following was the fate of those candidates for Parliamentary honours who were actively interested in aviation :—

Elected

Major J. L. Baird, C.M.G., D.S.O., Parliamentary Secretary to the Air Ministry. Rugby. Majority, 3,926.

Capt. Wedgwood Benn, D.S.O., D.F.C. (Liberal), Leith, beat the Coalition Unionist (old member) by 2,725 in a three-cornered contest.

Lieut.-Col. J. T. C. Moore-Brabazon, M.C. (Coalition Unionist), Rochester (Chatham). Majority, 7,320, in three-cornered contest.

Lieut. Alan Burgoyne (Coalition Unionist), Kensington, N. Majority, 9,523.

Lieut.-Col. C. L. Malone, R.A.F. (Coalition Liberal), Leyton, East. Majority, 200, in three-cornered contest.

Lieut. A. B. Raper, R.A.F. (Coalition Unionist), Islington, N. Majority, 3,384, over old member. There were five candidates.

N. Pemberton Billing (Independent), Hertford. Majority, 2,470.

Not Elected

Capt. W. G. Aston, R.A.F. (National Party), Paddington, N. Beaten by the Coalition Unionist by 1,730 votes. There were six candidates.

Lieut. Wright-Burrows, R.A.F. (Liberal), Hackney, N. Beaten by the Coalition Unionist by 5,754.

Lieut.-Col. Thomas Carthew, D.S.O. (Coalition Unionist), West Ham, Silvertown. Beaten by Labour Candidate by 2,712.

Inspecting German Naval Aviation Stations

THE Allied Naval Commission which recently visited Germany to see that the conditions of the Armistice had been carried out included the following flying officers : Brig.-Gen. Masterman, C.B.E., R.A.F. ; Comdr. W. Childs, U.S.N. ; Col. Clark-Hall, D.S.O., R.A.F. The parties which visited airship and seaplane stations reported that discipline and order were found to be better than in the warships, and apparently every endeavour had been made to live up to the letter of the Armistice agreement. The Norderney seaplane station was reported as comparing most favourably with any other of the kind in France or England, while the great Nordholz Zeppelin station is the finest in the world. It was from here that practically all of the England-bound raiders started, and not the least interesting sight observed there by the Sub-Commission was the famous "L 14," with 24 visits to England to its credit. It was practically the only survivor of the first raiders, all of the rest having perished in one way or another. "L 14" was being used as a school ship during the last months of the War, and the latest airships, such as the mighty "L 71," outclass it completely for power, speed, size and stability.

Another interesting visit of one of the Sub-Commissions was to the wreck of the Zeppelin sheds at Tondern. It was this station which was so successfully bombed by aeroplanes launched from the "Furious" last summer, when two sheds and two Zeppelins were completely demolished.

One of the most interesting visits was to the experimental station at Warnemunde, where all the new types of aircraft were tested. Permission to visit this station was granted only under protest.

French Memorial to Wilbur Wright

AT last a commencement has been made with the memorial to Wilbur Wright at Le Mans, where the Wright aeroplane was first demonstrated in Europe a little over ten years ago. On December 22nd, the foundation-stone was laid by Mr. W. G. Sharp, the American Ambassador, and M. Henry Simon, Minister of the Colonies, representing the French Government, in the presence of a large number of visitors, including representatives of the American and French Aero Clubs, American and French naval and military officers and Government officials. The site selected is in the Place des Jacobins, just by the Cathedral. The memorial, which will be the work of M. Paul Landowski, will stand on a broad base, from the centre of which will rise a pinnacled rock symbolising the summit of the earth, and on the top of this will be the figure of a man striving to climb higher. Inscribed on the monument is to be a quotation from Victor Hugo—

" I have the wings,
I aspire,
My flight is sure,
I have the wings for the tempest and for the azure."

Facing the Place will be a representation of the "inventor of the modern aeroplane." The ceremonies on December 22nd also included the presentation of a commemorative tablet to Le Mans by the Aero Club of America and a memorial tablet and bronze wreath from the citizens of Daton, O., Wilbur Wright's birthplace.

THE REPORT OF THE CIVIL AERIAL TRANSPORT COMMITTEE

APPENDIX II.

Interim Report of Special Committee No. 2.

Introductory.

The Special Committee were requested to advise as to the practical possibilities of aeronautics from a scientific and technical point of view, with special reference to certain detailed subjects which of necessity call for consideration in connection with this branch of the Main Committee's enquiry. Before these detailed subjects are dealt with, the Special Committee think it advisable to emphasise some general considerations. Since aeronautics represent in their civil and commercial aspect an untried field of enterprise, it is impossible to arrive at very definite conclusions in many of the subjects considered by the Special Committee, particularly owing to the fact that the technical and scientific data at present obtainable are applicable to aircraft used only for naval and military purposes, and to conditions of flight varying widely from those which will prevail after the War. In this connection, it should be remembered that the whole trend of design has been towards efficiency in the fighting machine, and, consequently, there has been little opportunity for research and enquiry into possibilities of the commercial uses of aeroplanes and airships.

The same considerations apply to those branches of the Special Committee's enquiry which deal with the practical running of aerial services on commercial lines.

With regard to the detailed subjects assigned for consideration by the Special Committee, these have been in most cases referred either to small sub-committees or individual members of the Special Committee, and the present report is intended to present the conclusions which can be drawn from the materials supplied in this manner. The Main Committee will observe that it has not been possible as yet to cover the whole field of enquiry, but it has been thought that the conclusions at present reached can conveniently be summarised in an interim report. It is, therefore, proposed to deal with the different items of the terms of reference to the Special Committee in order.

I. The possibilities of the employment of aircraft at present and in the near future in transporting passengers, mails, and parcels, with the estimated limits of their range, weight, carrying capacity, and running costs, based on the assumption of reasonable State regulation of air traffic, and the probability or otherwise of the use of privately owned aircraft by individuals for pleasure or other purposes.

Types of Aircraft.

In considering the possibilities of the employment of aircraft for purposes of the transport of passengers, mails and parcels, the Special Committee directed an enquiry* to be made as to (i) four existing types of aeroplane, and (ii) rigid airships. These were made the subject of reports by Col. O'Gorman and Mr. Bairstow, as to the aeroplanes, and by Wing Capt. Maitland, as to the airships, which are appended to the present Report as Appendices A and B†. With regard to aeroplanes, the following four types were selected, viz. :—

(i) The Handley-Page, with 250 h.p. Rolls-Royce engines, and the "America" flying boat.

(ii) The de Havilland 4, with 250 h.p. Rolls-Royce engine or 230 h.p. B.H.P. engine.

(iii) The R.E. 8, with the R.A.F. 150 h.p. air-cooled engine.

(iv) The Sopwith "Pup," with an 80 h.p. Le Rhone engine.

These types were selected to cover the whole range of well-known machines with a view to estimating the possibilities of transport from existing data.

Col. O'Gorman and Mr. Bairstow presented the following general conclusions to the Special Committee on the hypothesis of aerial transport in still air.

A. It is profitable, so far as fuel consumption is concerned, to fly high.

B. It is profiatble, so far as fuel consumption is concerned, and so far as the cost of aeroplane construction is concerned, to use a heavy loading of the wings.

C. Since high-wing loading means fast alighting, the provision of first-class grounds will, it is considered, lead to economy of transport. Your Sub-Committee contemplates landing speeds upwards of 60 m.p.h. This does not refer to seaplanes or flying boats.

D. High speed of flight is in direct conflict with great weight carrying capacity.

E. It follows from D that, in selecting the flying speed of the aeroplane to be used, a compromise must be struck between the value of (*a*) fuel and labour economy and (*b*) speed or time saving.

F. As illustrating E, a lightly loaded aeroplane, such as is commonly used now, cannot possibly at 120 m.p.h. (low level speed) fly 1,000 miles, that is to say, there will be no lift available to carry even the flyer; whereas, at 80 m.p.h., no less than 30 per zent. of the gross weight of the aeroplane becomes available for crew and commercial load.

G. The comparatively small importance of rapid climbing in commercial air work will make the possibilities of combining high speed and weight-carrying much better than those of the modern service aeroplane.

H. The cost of production of aeroplanes (taken over the range of variations of type presented by the four service aeroplanes selected and based on quotations for large quantities) is roughly proportional to the total crew and useful load carried; and this in turn is equally proportional to the total gross loaded weight of the aeroplane, viz., at war prices about £900 per every 1,000 lbs. of gross weight.

With regard to conclusion F, it was pointed out by way of explanation in a supplementary note (at the end of Appendix A) that a comparison is drawn therein not between two performances of one machine, but between performances of two different machines, one designed to fly at 120 m.p.h., and the other at 80 m.p.h. Particular attention is drawn to the tables annexed to this Report.

These conclusions were discussed by the Special Committee, and a further report was asked for from Col. O'Gorman and Mr. Bairstow as to the effect in a 1,000-mile journey of an adverse wind on the choice of the flight speed of an aeroplane. This further report is appended as Appendix C. The table attached to this further report sets out the available weight of crew and commercial load per 1,000 lbs. of total loaded weight, as affected by adverse and favourable winds over the journey named.

In making any definite recommendations as to commercial transport by aeroplane the Special Committee have felt that, for the reasons stated in the beginning of this report, it is impossible at the present stage to fix upon any particular type, and, therefore, they present the following general conclusions from the technical point of view.

Conclusions as to Aeroplanes.

(i) That for commercial success speed is probably the most material factor.

(ii) That for commercial success the speed needed depends very greatly on the conditions of competing methods. Between large centres connected by direct high speed railways, ground speeds of 100 m.p.h. are desirable, but for linking places between which the railway service is slow or interrupted by sea crossings, lower speeds will be found commercially practicable.

(iii) That, at present, stages of about 500 miles would be the normal limit, but that it will be desirable from the commercial point of view that stages should be as long as possible.

(iv) That it is desirable as speedily as possible to develop the existing facilities for night flying, especially for the carriage of mails.

(v) That heavy loading is necessary for commercial success, but, since this will involve a high landing speed, development of land and air brakes is necessary.

(vi) That in view of certain disadvantages of high landing speed, efforts should be made to keep loading as low as possible consistently with securing a commercial rate of speed and to provide for aerodromes and landing places possessing the best possible surfaces, and that it may well be hoped that future inventions and improvements in design will enable a lower landing speed to be attained without sacrifice of flying speed.

Airships.

With regard to airships, the report of Wing Capt. Maitland is appended to this Report as Appendix B. The Special Committee desire to draw special attention to the fact that in airships above a certain size the proportion of available lift, *i.e.*, crew, fuel, ballast, passengers and merchandise, to total weight increases rapidly, rising to as much as 50 per cent. in the case of a rigid airship with a gross lift of 60 tons, of 2,000,000 cubic feet capacity, and, therefore, from the commercial point of view there are obvious advantages in having airships of large size. Further, the conclusion can be drawn from that report that increase in size can be readily accompanied by increase in speed, as the weight of additional engines would occupy a very small proportion of the extra lift. The proportion of disposable lift in the case of non-rigid airships is less, at least in the case of non-rigid airships of the largest size at present known. The Special Committee have come to the conclusion that for commercial purposes the rigid type offers certain advantages over the non-rigid. In a further report (Appendix D*), Capt. Maitland works out some valuable statistics as to the effect of adverse wind and ascent in a 1,000-mile journey.

Prime Cost.

It is practically impossible to give any satisfactory estimate of running costs of either type of aircraft from existing data. With regard to the prime cost of machines, Appendices A and B contain curves showing the relation of gross weight to cost and useful load to cost, based on approximate war prices.

General figures relating to cost must be considered as indicative only; the weight of an aeroplane is not a definitely fixed quantity, and the amount of commercial load depends on the length of journey. An upper limit to the amount of commercial load is given in Appendices A and B under the name of "disposable load," this term including both crew and fuel. A lower limit is obviously zero when the journey is so long that the whole of the "disposable load" is absorbed by the crew and fuel.

Figures qualified as above are :—

	Prime cost per lb. of gross weight.	Prime cost per lb. of disposable load.	Prime cost per lb. of commercial load.
Aeroplane (high speed)	18*s.*	40*s.*	Upwards of 40*s.*
Aeroplane (low speed)	18*s.*	30*s.*	Upwards of 30*s.*
Airship (rigid) ..	9*s.*	18*s.*	Upwards of 18*s.*

Mail Services.

The question of the carriage of passengers or of goods has not yet been considered by the Committee except from the technical point of view of the range and weight-carrying capacity of aircraft generally, but the Committee hope at an early date to report further on this important branch of their subject, and on the closely connected question of the probability of the use of privately-owned aircraft by individuals. In regard to what follows with respect to air mail services it should be understood that the Committee consider that in so far as the useful load-carrying capacity of the aircraft is not fully occupied by the transportation of mails it should be employed in the conveyance of passengers and even of small parcels of valuable goods.

It has been pointed out above that it is desirable from the commercial point of view that stages should be as long as possible. This principle is illustrated with peculiar clearness in the case of mail services. A London-Paris air service, for example, should be effected in 2½ hours, or less, as against, say, seven hours by the land or sea route. An air mail service would here enjoy a very evident advantage as compared with any other. With longer Continental flights, such as that from London to Paris, and then on to Turin, greater savings of time should be possible as compared with existing means of communication. In the case of the Italian mail, the time saved might amount to as much as a day. The longer the flight the more important is the time saved, and, consequently, the better are the prospects of an aerial mail service. There is, for example, nothing impossible, given the proper facilities, in sending mails by air from London to Calcutta in four days, as against 16 days (minimum), or from London to Johannesburg in six days as against 19. When the importance to business of full and rapid communication, and the great cost of trans-ocean cabling is borne in mind, it appears perfectly reasonable to anticipate that people will be willing to pay a price per ounce for letters carried by aircraft sufficient to make these long distance air mail services commercially profitable. A cable message of 100 words from London to Johannesburg to-day, at 2*s.* 6*d.* a word, costs £8 10*s.*, and 24 hours at least usually elapse between the despatch of a message from London and its delivery to the addressee. A letter of 5,000 words need not weigh more than an ounce or two. If such a letter could be sent in six days, even at 2*s.* 6*d.* an ounce, the saving in cost would be enormous, and the extra time taken by this means of communication as compared with the cable would in many cases be more than compensated for by the avoidance of the risk of misunderstanding inseparable from the use of the necessarily abbreviated language of cable messages.

The case is naturally different as regards air mail communications within Great Britain. In the case of services from London to large provincial towns, it may be said to require a flight of at least three hours, at an average, say, of 100 miles an hour, for the speed of an air-mail service to reveal itself and for this speed to offer a sufficiently marked saving of time over land transit, remembering that one must reckon the time taken in establishing the land connections of an air service. When an oversea journey is made, such as the passage across the Irish Sea in a flight to Dublin, the saving of time offered by an air service is much more evident, and the same holds good in the case of cross-country routes, *e.g.*, from Cardiff or Bristol to South-

* With regard to the types of aeroplanes selected, it should be noted that this enquiry was directed in July, 1917.

† Not printed.

* Not printed.

ampton, where express rail services are lacking. Attention is drawn to Appendix E, outlining a scheme for an experimental air-mail between London and Glasgow. Mr. Murray, criticising this memorandum at the meeting of the Special Committee on October 12th, considered that a load of 100 lbs. of mails per machine, and not 1,000 lbs., was all that could be hoped for, at any rate, in the early stages of such a service. No definite figures have been arrived at, so far, as to the financial aspects of an air-mail service. In Appendix E, just referred to, Mr. Holt-Thomas's estimate of 4*s.* 8*d.* a mile for overhead charges and running costs for an air-mail service between London and Paris (as outlined in his lecture before the Aeronautical Society on May 30th, 1917) was adopted in the absence of other data. So far as a service in the United Kingdom is concerned, assuming the correctness of Mr. Murray's view that only a very limited volume of express mails would be available (having regard to the excellence of existing methods of communication), then it would become necessary to charge some high fee, such as 1*s.* or more per letter, if there is to be any hope of an air-mail service proving remunerative. The Committee, however, are sanguine enough to hope that Mr. Murray's estimate may be somewhat too conservative, and the matter is being considered in greater detail.

In view of the great advantages anticipated in suitable instances, the Special Committee definitely recommend the institution of experimental mail services without waiting for the end of the War, if this is consistent with naval and military interests, but Mr. Murray desires to record his opinion that the out-of-pocket cost, if any, of such experimental services should be borne, not by the vote for the G.P.O., but by that of the Department most immediately concerned, presumably the Air Ministry.

II. The possibility of little-known or unexpected inventions modifying the lines of present development.

The Special Committee concur in the following conclusions drawn up by Lord Montagu, Mr. Lanchester and Mr. Wells on this branch of their enquiry.

"It is considered that, whilst there may be considerable development in the appliances for flying at present known and available, namely, the aeroplane and the airship or dirigible balloon, and in the engines they use, these developments afford no prospect of more than a quantitative modification of existing conditions.

"So far as the aeroplane is concerned, there is every probability of considerable improvement. Such things as an increased use of folding wings, a device already used by the R.N.A.S., minimising the storage capacity required and improving braking mechanism—under which head we may include reversible engines and propellers, and other forms of brakes—diminishing the amount of space needed for landing, may be anticipated. Beyond this, it is thought that an all-round improvement in efficiency and weight-saving may be expected. These improvements will probably only slightly modify the general outline of the problem. The helicopter has been considered, as well as possible combinations of airship and aeroplane. The latter alone seems to involve the remotest possibility of affecting present practice to any serious extent.

"On the question of fuel, every effort should be made by State aid or State encouragement to widen the basis of fuel production as much as possible, and to prevent the enormous interests in connection with automobilism, both on land and in the air, being dependent upon fuel of any one given kind, especially if that be derived from overseas or foreign sources of supply. Attention is called to the fact that fuel supply for aircraft cannot be considered apart from the fuel supply of motor vehicles of other kinds, *i.e.*, private cars, 'buses, lorries, etc. Whereas on the fuel question, as in the case of the machines themselves, there is no sign at present of any revolutionary development, the fact must be recognised that it may at any time become possible by chemical discovery to produce volatile hydro-carbon fuels in great quantities at comparatively small cost. While it cannot be definitely asserted that undiscovered methods of synthetic production exist, it is known that in the matter of chemical discovery the possibility is always there, and it is not possible to say, when speaking of fuel, that the future can be forecast with any degree of certainty."

In addition to these conclusions the Special Committee are of opinion that the following lines of invention are of great importance to commercial aeronautics, viz., the gyroscope and its incidental uses, the turbine system applied to combustion engines, and directional wireless.

III. The Rules that will be required for aerial traffic regulation, routes, and zones, signalling and lighting of routes and landing places, night flying, wireless communication, dissemination of meteorological information, safety appliances and prohibited areas, illustrated by one or more actual routes assumed to be in use by an organised aircraft service.

Rules of the Air.

With regard to rules for aerial traffic regulation, viewed from the point of view of domestic control, the Special Committee approve of the existing code of rules drawn up by the Royal Aero Club. These rules are appended as Appendix F to this report. These rules are aimed mainly at preventing collisions in the air, and some additions will be necessary to deal with problems arising from the ascent from and descent to aerodromes. The Special Committee will report further on such additions when they have had the opportunity of considering certain military and naval regulations to be applied in the case of existing aerodromes. With regard to traffic regulations from the international point of view, the Special Committee are proposing to report to Special Committee No. 1, particularly as to certain proposed regulations contained in the 3rd Annex to the Draft Convention of Paris of 1910, which will require revision in the light of the recent developments of aeronautics generally.

The Special Committee do not at present make any recommendation as to different altitudinal zones for different types of aircraft, although they recognise that in the future some regulation on this subject may become necessary.

Air Routes Generally.

In considering the planning and definition of particular air routes, certain general considerations arise. In the case of a commercial aerial service the route will generally begin or end at some large town or centre of population, but its course may vary in accordance with the needs of intermediate towns in a popluated country and in accordance with the factors of prevailing winds and landing facilities in the case either of long journeys over undeveloped countries or of long journeys over the sea.

In the two latter instances the necessity for a planned and defined route is sufficiently obvious, for in the case of a flight over, *e.g.*, Africa, the provision of landing facilities on a liberal scale is impracticable, and in the case of a flight from America to Europe prevailing winds will play a large part in fixing outward and homeward tracks. In the United Kingdom, or at any rate in England, present and future military requirements will involve the creation of a large number of landing grounds, but where mails have to be delivered, the provision of definitely marked routes is necessary for the sake of economy, speed, reliability, and safety of navigation.

Landing Grounds on Air Routes.

As to the provision of alighting grounds, the Special Committee have not felt justified in committing themselves to a definite recommendation that landing places are required at fixed distances along aerial routes. What it is thought will happen, in the ordinary course of development, will be for main aerodromes to be established in the neighbourhood of the large centres of population, and then for these main aerodromes to be connected by the institution of subsidiary aerodromes near smaller centres of population; while purely emergency landing grounds along the various routes will be placed, not so much with the idea of their being at regular intervals, but rather with a view to providing safe alighting points in localities where the nature of the country might render dangerous an involuntary descent.

To illustrate the problems which may arise as to aerial routes, the Committee desire to draw attention to certain conclusions which may be drawn from reports obtained from their members as to certain specified routes arbitrarily chosen. These reports were submitted to the Committee by the following members:—

(*a*) London — Edinburgh — Glasgow — Dublin —London	Maj.-Gen. Ruck.
(*b*) London to the Riviera	Mr. Holt-Thomas.
(*c*) London to South Africa	Lord Montagu.
(*d*) The Atlantic Route	Comdr. Porte.
(*e*) London—Norway—Sweden—Russia ..	Maj.-Gen. Ruck.

In drawing up these reports it has not been possible to work out in detail the precise provision that will be required on each for signalling and lighting and for other matters mentioned in heading III (quoted above) of the terms of reference to the Special Committee. Decisions as to what is required in these respects on particular routes can only be arrived at by actual experiment, and the Special Committee have therefore confined themselves to such general propositions as can be affirmed with some measure of confidence in the light of existing knowledge.

London—Edinburgh—Glasgow—Dublin—London.

As to (*a*) it appears that, so far as the existence of landing grounds is concerned, the most attractive route northward at the present time would follow the line of the Great Northern and North-Eastern Railways, viâ Berwick. In so far as the route to Edinburgh is viewed in the light of direct transit, regardless of intermediate stops, this line offers the greatest advantages on the score of time-saving; but when the possibilities are considered of linking up important centres of population, a route to the westward covering, *e.g.*, Bedford, Northampton, Leicester, Nottingham, Sheffield, and Leeds may be preferable. As against this route it should be mentioned that in some conditions of weather pilots prefer to proceed along the coast as far as possible. The creation in the future of further landing facilities may considerably modify conclusions as to the best route to Edinburgh from the commercial point of view, and the possibility of planning a route generally to the westward of the East Coast line must not be lost sight of.

The route from Edinburgh to Dublin might pass Glasgow and Belfast, viâ Kilmarnock, Ayr, Stranraer, Belfast, Portadown, Dundalk, and Drogheda. On this section the route is more or less undeveloped as far as landing grounds are concerned.

From Dublin to London the route might follow the track of the mail steamers to Holyhead, and thence the line of the present London and North-Western Railway, viâ Chester and Crewe, assuming it to be a part of what would ultimately become a West Coast route to Scotland, viâ Manchester and Liverpool. At present there are objections to a West Coast route to Scotland, owing to the mountainous nature of the country north of Carlisle and the absence of landing grounds. In fact, the most direct line from North Wales to London would turn off near St. Asaph and go straight to Birmingham. Landing facilities from the military point of view already exist on this route from Tern Hill, near Market Drayton, through Birmingham, Coventry Rugby, and Aylesbury.

London to the Riviera.

As to (*b*), the route from London to the Riviera, this does not call for much comment, except that it will probably follow the line of Paris, Dijon, Lyons, and Marseilles, showing a saving of time from London to Marseilles of something like 17 hours. An alternative route would be to fly from Avignon direct to Cannes, leaving Marseilles and Toulon on the right, thus effecting a considerable saving in distance.

London to South Africa.

As to (*c*) the routes from London to South Africa, Lord Montagu furnished particulars of an Eastern route, viâ Marseilles, Naples, Crete, Egypt, and the Valley of the Nile, and Northern Rhodesia, and a Western route, viâ Bordeaux, Gibraltar, and the Sahara, Lagos, Angola, and Rhodesia. The total distance of the Eastern route is some 7,800 miles, and the Western route some 7,210 miles. On a theoretical basis of a speed of 80 miles per hour and continuous flying for 24 hours per day, the time taken by the Eastern route would be 4 days 1½ hours, and by the Western route 3 days 18 hours. Lord Montagu pointed out in his report that meteorological conditions, generally speaking, favoured the use of the Eastern route from the United Kingdom to South Africa and the use of the Western route on the return journey from South Africa to the United Kingdom. Whichever route may in the future be found to be the better, or whether it may be found desirable to operate both, the Committee can at this stage only recommend that a practical experiment should be instituted on either or both routes at as early a date as possible. The Eastern route would appear to be commercially the more important, and would pass mainly over British territory. It would be easy to exaggerate the importance of this latter consideration in connection with future commercial aerial traffic generally, but for the purposes of conducting an experiment there are obvious advantages in having to deal with territory under the jurisdiction of His Majesty rather than with foreign territory.

The Atlantic Route.

As to (*d*), the Atlantic route, Comdr. Porte pointed out in his report that for some time to come a direct route from Ireland to Newfoundland and *vice versa* will be found impracticable. He suggested that the only possible solution of the Trans-Atlantic route at the present time and for many years to come, would be to use the so-called "Azores" route, employing San Miguel, the principal island of the Azores, as a landing station. To avoid the great distance of a direct flight from the United Kingdom to San Miguel he recommended a route from London viâ Paris, Madrid, and Lisbon, the distance from Lisbon to San Miguel being 775 miles. From San Miguel to Newfoundland is 1,346 miles, although this distance could be reduced to 1,045 miles by calling at Flores, another of the Azores group. The use of Newfoundland as a terminus presents great difficulty owing to continual fog on the banks and around Newfoundland itself.* The effect of this fog is to make a journey westward to Newfoundland liable to the danger and uncertainty involved in having to come down to land through the fog. The same difficulty does not occur in the eastward journey from Newfoundland, in that the pilot can lay his course by the compass and would within a comparatively short period find himself outside the fog area.

Comdr. Porte's conclusion is that, at any rate in the immediate future, it would be preferable to fix upon New York as the Western terminus of the Atlantic route. The distance from San Miguel to Long Island is roughly 2,250 nautical miles, and Comdr. Porte suggests that for the purpose of dividing this long distance into reasonable stages, it would be necessary to design and arrange for "Sea Stations," in the shape of long ships of, say, 600 ft., with a clear upper deck of 400 ft., fitted with wireless and the necessary signalling

*See the heading "Aerial Routes" in the final report of this Special Committee.

apparatus. Such an arrangement would make possible the use of aeroplanes rather than seaplanes.

While Comdr. Porte is a high authority, the Special Committee do not feel that they possess sufficient independent information to enable them to express a confident opinion with regard to his conclusions. So far as these are based upon the prevalence of fog on the Newfoundland coast, Major Taylor is disposed to think that they are open to question. Maj. Taylor's impression, based upon his study of the subject, is that the sea fogs prevailing off the Newfoundland coast are low in altitude and do not extend far inland. Any further evidence that could be obtained on this point would be valuable.*

Here again, the Committee can only recommend that a practical experiment should be instituted as early as may be possible, all available information as to the weather conditions likely to be encountered that may be in the possession of the Meteorological Office or of the Governments of the U.S.A., Canada, and Newfoundland having first been studied with a view to undertaking the experiment with the best chances of success.

This route would appear to be a particularly suitable one for an experiment with airships as well as with aeroplanes, the distance in a direct line from the East Coast of Newfoundland to the East Coast of Ireland being no more than could be accomplished in favourable weather by airships already in existence.

London to Russia.

As to (*e*), the route from the United Kingdom to Russia, viâ Norway and Sweden, it was suggested to the Committee that a service might be conducted from London to Yarmouth by aeroplane, a distance, approximately, of 100 miles; by seaplane from Yarmouth to Christianssand, a distance of approximately 450 miles; by seaplane from Christianssand to Stockholm, crossing the Swedish lakes, a distance of approximately 360 miles, and, as a final stage, from Stockholm to Petrograd by seaplane, a distance of approximately 450 miles, crossing the Baltic and continuing up the Gulf of Finland. The total distance would be about 1,360 miles. The progressive reliability of aeroplanes will probably, within a short period, render the use of seaplanes unnecessary. This route, also, might afford a favourable opportunity for the use of airships.

Marking of Aerial Routes.

As to the marking of aerial routes, several recommendations have been made.

Wing Capt. Groves has suggested that all main routes should be marked at intervals of five miles by a strip, 200 ft. in length and 16 ft. in breadth (formed of chalk or small stones treated with some white mixture), each mark pointing exactly along the line of route. He recommends, also, that alongside each mark should be an alphabetical letter, 50 ft. in length, to indicate the routes to which they belong; while in addition to these letters, each mark should have its distinguishing number, in figures 16 ft. high. In clear weather these figures would not be required by the pilot, but in thick weather, rain, or other adverse conditions, they would help him to discover his exact whereabouts.

Lieut.-Col. O'Gorman, after considering the memorandum by Capt. Groves, suggested that main railway routes should be identified by various combinations of dots and dashes formed by lines of chalky stones, but the representative of the Board of Trade expressed the view that there would be serious difficulties in the practical working of this proposal.

Generally speaking, and in the light of the information before the Special Committee, it would appear that, in anything like favourable weather, a pilot has no difficulty in finding his way from point to point, correcting his compass course by visual observations of prominent landmarks, and by following railways when they are on his line of flight. This applies particularly to the aviator who flies frequently over any given route, as, for example, in the case of the "ferry" pilots who take new machines by air from London to G.H.Q. in France, or to Montrose in Scotland. These pilots find it so easy to steer an accurate course by compass and visual observations of landmarks and railways that they have, apparently, never even considered the need for artificial markings.

When clouds are low, however, and an aviator may have to fly as low, perhaps, as a few hundred feet in order to correct his compass course by an observation of the ground, it is considered that artificial markings would be extremely useful; and one suggestion which has been made, and which meets with the approval of the Special Committee, is that the roofs of railway stations or sheds should have their names painted upon them in letters large enough to be distinguished by the pilot of an aircraft. It would be of great advantage that these letters should be brightly illuminated at night.

The Special Committee recognise that while it may meet the case for a military aviator to find his way from one landmark to another, or to follow some convenient railway, even should this take him a little from his course, a commercial pilot, carrying mails, say, from London to Paris, will find any deviation from the direct line reflecting itself adversely not only in his time-table, but also in the matter of fuel consumption. It may be thought necessary, therefore, by those who operate such commercial services, to lay down some very clear system of landmarks, so as to ensure an absolute adherence by their pilots to a given line of flight. The placing of such marks on private ground will, of course, be a matter of arrangement between landowners and aircraft companies; though it would appear advisable that there should be supervision by the authorities to prevent any possible confusion arising through the use by various companies of different schemes of marking.

Night Flying.

As to night flying, at any rate on a commercial scale, it is recognised that some special method of illuminating aerodromes and intermediate points, so as to enable pilots to land and also to afford them a means of checking their compass course, and to help them in combating the difficulties of ground mists and fogs, will need to be adopted; but this question has not yet been considered in detail.

Meteorological Information.

The dissemination of meteorological information has obviously a very important bearing on the development of civil aerial transport, particularly from the point of view of the safety and punctuality of services which will require to run to time-tables. Much meteorological knowledge has, of course, been accumulated for many years by the Meteorological Office, but as such knowledge has hithero been required almost wholly for the purpose of persons moving over the surface of land and sea, the study of the meteorology of the upper air, which is all-important for the purpose of aeronautics, is in a less advanced condition. The first steps must be in the direction of collecting the required body of knowledge and arranging for the tabulation of the data, as they vary from hour to hour. This involves at the outset much scientific study and research, a branch of our subject which falls primarily within the scope of Special Committee No. 5, by whom, however, we have been supplied with two valuable papers by Maj. Lyons and Sir Napier Shaw, which are attached as Appendices to the interim report of that Special Committee.

Assuming measures to have been taken for the collection of the necessary scientific knowledge, it remains to consider measures for making it readily and easily accessible to the pilots and others concerned for the purposes of practical flying. Many useful suggestions in regard to this matter are contained in Sir Napier Shaw's paper, and the subject has also been dealt with by a Sub-Committee of Special Committee No. 2, consisting of Lord Montagu and Maj. Taylor. Their report, with the conclusions of which we agree, is appended (Appendix G). We particularly desire to emphasise the importance of the establishment at each main or "terminal" aerodrome of what Sir Napier Shaw has described as a "Map room," in charge of a person capable of explaining rapidly and intelligently to practical pilots the meteorological conditions likely at the moment to be met with in the vicinity. Such establishments, if they are to be efficient, presuppose the frequent direct communication to them by pilots of information as to the conditions actually experienced by them in their flights. The importance of making such communications should be impressed upon pilots, and commercial machines should be fitted for this as well as for other purposes with wireless telegraphic apparatus. It will appear from a report by Col. O'Gorman and Maj. Vincent Smith (Appendix H*) that this requirement should eventually present no serious difficelty, since it is to be expected that a large commercial machine would not be navigated by one pilot working single-handed, but that the pilot would ordinarily be accompanied by at least one assistant who would be able to send the requisite wireless messages without difficulty.

The Committee have ascertained from the Admiralty that there exists a complete system of Naval Meteorological Stations in the United Kingdom in direct communication with the Admiralty Office in London. These stations are run at a small cost, a staff consisting of an officer and three men being sufficient for day and night duty. At most of these stations weather maps can be prepared. Although these stations have not been established solely for aeronautical purposes, the Committee think that their assistance may well be invoked in connection with a scheme for disseminating meteorological information, and at least they can serve as models for stations to be established in connection with terminal aerodromes.

Prohibited Areas.

With regard to the question of prohibited areas, the Special Committee are not yet in a position to submit a report.

Safety Appliances.

The Committee have taken into consideration the use of safety appliances in commercial aircraft. These will no doubt be largely developed by experiment after the conclusion of the War, and the Committee would draw special attention to the different lines of enquiry with regard to safety appliances suggested in a report by Capt. Maitland and Col. O'Gorman (Appendix I), with which the Committee concur.

IV. The estimated number, size and location of landing grounds suitable for an organised aircraft service, with the technical requirements of management staff and maintenance and the estimated running cost of such grounds.

Landing Grounds Generally.

As stated earlier in this report, the Special Committee do not advise the provision of landing grounds at fixed distances on aerial routes, although they hold the view that in the case of main routes the safety and regularity of commercial services will largely depend on the existence of a sufficient number of alighting points lying along the line of route.

Generally speaking, the positions selected for aerodromes or landing grounds should comply with the following conditions:—

(1) Bear some reference to the direction of the main aerial routes;
(2) Be sufficiently far from the centres of cities to be fairly clear of houses in the direction of flight;
(3) Be unlikely to be shut in by buildings in the immediate future;
(4) Be as far as possible clear of railways, telegraphs, trees and other obstructions;
(5) Be situated on ground as far as possible free from mist and fogs;
(6) Be provided with adequate water supply, telephone connections and good facilities for rail, tram, 'bus and motor traffic with the different districts of the cities to be visited;
(7) Be capable of expansion.

Aerodromes and Intermediate Landing Places.

With regard to aerodromes, the Committee has obtained a report from Col. O'Gorman, Mr. Holt-Thomas and Mr. Lanchester, and with regard to intermediate landing places a report from Capt. E. Elvey Robb. These reports are attached as Appendices J and K. The Committee agree with these reports generally, and consider them valuable as indicating the possible requirements of the future, when there has been time for civil aerial transport to develop itself on a considerable scale. As things stand at present, however, it must be borne in mind that the exigencies of the War have already led to the establishment in all parts of the country of aerodromes and landing places with an equipment fully sufficient to deal with any civil air traffic to be expected in the earlier days of peace. The reports should not therefore be read as indicating that it will be necessary in the near future to set up new and elaborate organisations with consequent heavy expenditure for the purposes of civil air traffic alone.

Generally speaking, the Committee hold the view that, subject to necessary military regulations, it is desirable to arrange for the user by civil aircraft of as many as possible of the intermediate landing grounds, which are at present or will in the future be under military control.

V. The estimated cost of maintaing an aerial service, including aerodromes, sheds, landing grounds, labour, wages, running expenses, depreciation and repairs, exclusive of capital charge for the purchase of machines on the assumption of a route of definite length and the employment of a definite number of aircraft thereon.

VI. To advise in the light of the answers to the foregoing questions as to the main aerial routes which might be marked out and prepared for now for utilisation by an aircraft service.

On these two branches of their enquiry the Special Committee are not yet in a position to submit a report, although certain matters which fall within paragraph VI. have already been touched upon in that part of this report which deals with certain specified air routes.

R. M. Ruck, Maj.-Gen. (Chairman); Atholl; Leonard Bairstow; G. B. Cockburn; R. M. Groves, Wing Capt., R.N.; G. Holt-Thomas;† E. M.

* Not printed.

† Mr. Holt Thomas signs the report with the reservation that the adoption of a scheme of landing grounds on all main routes is, in his opinion, essential to the success of civil aerial transport as regards regularity of service, rapid conveyance by reserve machines in case of breakdown, and the effect on design and efficiency of machines. The landing ground scheme, in his opinion, should be adopted, and he sees in it the probable solution of many difficulties as regards flying in fog and by night, etc. He also puts forward the argument that the expense of any such scheme has already proved to be almost negligible compared with the cost of any service, and that therefore, taking into account the undisputed advantage offered, he is unwilling that this report should go out without expression of opinion on his part that the landing ground scheme on all main routes should certainly be recommended and adopted. On this point he is bound to totally disagree with the report, as he considers that in the absence of a landing ground scheme irregularities in aerial services may occur which may have a very dangerous effect on the future of aerial navigation in the opinion of the public.

* See the heading 'Aerial Routes" in the final report of this Special Committee.

Maitland, Wing Capt., R.N.; G. E. P. Murray; Mervyn O'Gorman, Lt.-Col.; Frank Pick; J. C. Porte, Wing Comdr.; J. W. Pringle, Col.; E. Elvey Robb, Capt.; W. P. Schreiner; W. Sempill, Wing Comdr. R.N.; T. Vincent Smith, Maj., R.F.C.; T. Sopwith; G. I. Taylor, Maj.; E. R. Wayland, Lt.-Col.; H. G. Wells; H. White Smith.

D. O. MALCOLM,
Secretary.
December 19th, 1917.

The following appendices to this report of Special Committee No. 2 have not been printed :—

A.—Report by Col. O'Gorman and Mr. Bairstow on four types of Aeroplane.
B.—Report by Brig.-Gen. Maitland as to rigid airships.
C.—Memorandum by Lieut.-Col. O'Gorman and Mr. L. Bairstow as to the effect of an adverse wind on the choice of the flight speed of an aeroplane.
D.—Report by Brig.-Gen. Maitland on a 1,000-mile journey by rigid airship.

APPENDIX E.

Memorandum by the Assistant Secretary (Technical) on the Establishment of an experimental air-mail service, one machine being run each way daily, weather permitting, between London and Glasgow, via Newcastle and Edinburgh.

It is assumed that, in an experimental service, started immediately after the war, only a limited quantity of express mails would be carried, at a fee determined by the Post Office, and that the bulk of the mails will still go, as at present, by land.

A London-Glasgow route has been chosen for illustration for several reasons. In the first place, it requires at least a three hours' flight, at an average, say, of 100 miles an hour, such as that from London to Newcastle, for the speed of an air service to reveal itself and for this speed to offer a sufficiently marked saving of time over railway transit, remembering that one just reckon the time taken in establishing the land connections of an air service.

In regard to cities which are, say, a four hours' journey by rail from London, such as Manchester, it is possible to "express" a letter in London at a reasonable hour in the morning, and for this letter—which goes by a fast train—to reach its destination well before the close of the business day. An express air service on such a route, therefore, even if it could cut down the time by an hour or so, as compared with the transit by train, would only be offering a business man a slightly additional convenience. He might, indeed, say that so long as his "express" letter reached its destination in time to be dealt with before the office to which it was addressed closed for the day that he was satisfied, and was indifferent whether the letter was delivered, say, at 2.30 p.m. or 3.30 p.m. But in the case of a city like Newcastle, or cities farther North, it is not possible to "express" letters in the morning in London, at any hour which might be considered reasonable for business purposes, and for these letters to reach such cities by train in time to be dealt with before the close of the business day. Therefore, by instituting a London-Newcastle-Edinburgh-Glasgow service, and by so arranging this service that a business man could post a letter in the morning in London or Glasgow, and for this letter to reach its destination before the close of the business day, one would offer the business world a very clear facility, which cannot be offered by any existing means of transit.

The use is assumed of an aeroplane which, carrying 1,000 lbs. of mails, will maintain an average speed of 100 miles an hour.

It is very necessary to consider the time occupied in establishing the land communications of an air service. Letters must be carried from the city to the aerodrome, and then, at the other end, from the aerodrome to the city. In the period immediately following the war, Hendon will, it may be assumed, be the London terminal aerodrome for mail services. It is assumed, also, that mails will be carried between the G.P.O. and the aerodrome in motor vans. In a year or 18 months after the war the Post Office will it is hoped, have in operation a miniature electric underground railway, carrying mails from East to West of London, and *vice versa*, at a maximum speed of 35 miles an hour. An extension of this railway from Mount Pleasant to the Hendon Aerodrome would enable mails to be carried from the G.P.O. to Hendon in about a quarter of an hour.

In the provisional time table which is submitted for a London-Glasgow service, three-quarters-of-an-hour has been allowed for each land connection and distribution of letters, as made by motor vans or motor cycles.

Provisional Time Table: London-Glasgow, Glasgow-London.
One machine each way daily.
London-Glasgow.

Posting is allowed at the G.P.O. up to 10.30 a.m., when the mail-bags are closed, and carried to Hendon in a motor-van. The time table is then as follows :—

11.15 to 2.15.—Carriage of the mails by air from Hendon to Newcastle. The distance in a straight line is about 250 miles; but an allowance is made for slight deviations on the part of the pilot, while a three hours' flight has been assumed for the convenience of obtaining a round figure. In actual working, however, taking the average speed throughout at 100 miles an hour, the journey should be accomplished in a little less than three hours. But, as against this, may be set such small losses of time, in the actual operation of a service, as cannot be calculated in advance. The aeroplane does not alight at Newcastle, but drops the Newcastle mail in a net, and continues its flight. The Newcastle mail is then carried into the city, and may be assumed to have been distributed by 3 o'clock. It might be found necessary in actual working to descend at Newcastle to pick up letters which Newcastle firms desired to send by air to Glasgow.

2.15 to 3.15.—The aeroplane continues its flight to Edinburgh. It does not stop at Edinburgh, the mail-bag for that city being dropped into a net, and the letters delivered by 4 o'clock.

3.15 to 3.45.—The aeroplane completes its last stage to Glasgow.

3.45 to 4.30.—Glasgow mail carried into the city and distributed.

Glasgow-London.

Posting is allowed in Glasgow up to 10.30 a.m. Then the mail-bags are closed and taken to the aerodrome. The timetable is then as follows :—

11.15 to 11.45.—The aeroplane flies from Glasgow to Edinburgh, alighting to pick up mails for Newcastle or London. It might also, if there were any, carry mails from Glasgow to Edinburgh.

11.50 to 12.50.—The aeroplane continues its journey to Newcastle, where it alights to unload and also to pick up.

*12.55 to 3.55.—The aeroplane continues its flight from Newcastle to Hendon.

* Newcastle firms wishing to send a letter by air to London would be able to post up to as late as 12.10 p.m. This would allow firms in cities near by, such as Gateshead, Sunderland and South Shields, to catch the air mail for London by sending in their letters to Newcastle by train; or an aeroplane might visit these neighbouring districts during the morning, collecting letters for London, which it would bring to the Newcastle aerodrome in time to catch the London machine. Such a system feeding the main route might be adopted also in other localities.

3.55 to 4.40.—The London mail is carried from Hendon into the city and distributed.

It may be useful to give an illustration of the facilities offered by such an air-mail service as that described :—

The Newcastle recipient of a letter, say, from London, after acquainting himself with its contents, might be able, in some cases to answer immediately by telegram or telephone, or he might prefer to write a more detailed answer which would go back to London in the ordinary way by evening mail, being received in London the next morning. If the recipient of the letter adopted the last-mentioned course, the air-mail being used only one way, there would still be a clear saving in time of a day, as compared with the existing routine of correspondence—this routine being for a letter to be posted in the evening in London, received in Newcastle the next morning, the answer being written and posted that day, reaching London on the third morning.

By courtesy of the Post Office, it is possible to state that at the present time, reckoning the mails despatched *both ways*, a total of approximately 260,000 letters and postcards are carried during a period of 24 hours between London, Newcastle, Edinburgh and Glasgow. Could it be assumed that each individual posting represented a letter weighing an ounce, then it would be possible to state that, if approximately an eighth of this existing volume of mail traffic could be transferred to the air, there would be sufficient to fill one machine each way a day—reckoning each machine to carry a 1,000 lbs. load. But it is the custom of the Post Office to place letters and postcards under one heading, and separate figures are not obtainable.

As to the financial aspect of the London-Glasgow air service, adopting Mr. Holt Thomas's figure of 4s. 8d. per mile for overhead charges and running costs,* the daily expenses of a contractor, operating one machine each way, would be roughly £198. As against this, at a full load both ways (a total of 32,000 ounces), the contractor's charge for carriage, to cover his bare expenses, would be almost exactly 1½d. per ounce. Assuming an express service, with a charge to the public of 4d. or 6d. per ounce, for a fair proportion of letters drawn from the total of 260,000 letters and postcards which has been mentioned in the paragraph above, it would appear that on a contract of carriage the Post Office could well pay the contractor a sum which would not only cover his bare expenses, but show a considerable profit in working.

HARRY HARPER.

10th September, 1917.

APPENDIX F.

Rules of the Air, as passed by the Committee of the Royal Aero Club

Regulations for Preventing Collisions in the Air.

(Passed by the Committee March 19th, 1912.)

In these regulations the term "foul" shall include the giving of dangerous backdraught to another aircraft.

Cross-country Flying.

(*a*) Two aircraft meeting each other end on, and thereby running the risk of a collision, must always steer to the right. They must, in addition to this, pass at a distance of at least 100† metres, taken between their nearest adjacent points.

(*b*) Any aircraft overtaking another aircraft is responsible for keeping clear and must not approach within 100 metres on the right or 300 metres on the left of the overtaken aircraft, and must not pass directly underneath or over such overtaken aircraft.

The distance shall be taken between the nearest adjacent points of the respective aircraft. In no case must the overtaking aircraft turn in across the bows of the other aircraft after passing it so as to foul it in any way.

(*c*) When any aircraft are approaching one another in cross directions then the aircraft that sees another aircraft on its right-hand forward quadrant‡ must give way, and the other aircraft must keep on its course at the same level till both are well clear.

Flying Grounds.

The following Special Regulations apply only to flying grounds :—

(*d*) Two aircraft meeting each other end on, and thereby running the risk of a collision, must always steer to the right. They must, in addition to this, pass at a distance of at least 30 metres taken between their nearest adjacent points.

(*e*) Any aircraft overtaking another aircraft is responsible for keeping clear, and in no case must turn in across the bows of the other aircraft after passing it, so as to foul it or risk a collision, and must, in addition, subject to Rule 12, conform to the following regulations :—

(1) If flying on the same level, *i.e.*, within 5 metres above or below, must pass outside the overtaken aircraft at not less than 10 metres.

(2) If on a different level, must not pass nearer than 10 metres.

The distance shall be taken between the nearest adjacent points of the respective aircraft.

An aircraft when being overtaken shall not alter its course or level, save when in the act of overtaking and passing another aircraft.

Flying to the Danger of the Public.

(Passed by the Committee November 11th, 1913.)

1. Flying to the danger of the public is prohibited; particularly, unnecessary flights over towns or thickly-populated areas, or over places where crowds are temporarily assembled, or over public enclosures at aerodromes at such a height as to involve danger to the public.

2. Flying is also prohibited over river regattas, race meetings, meetings for public games and sports, except flights specifically arranged for in writing with the promoters of such regattas, meetings, &c.

APPENDIX G.

Report on Weather Service for Aerial Transport.

The chief meteorological requirements for the guidance of Aerial Transport may be divided into three groups :—

(1) Statistical information.
(2) Forecasts.
(3) Knowledge of the momentary meteorological conditions along aerial routes.

(1) *Statistical information.*

Most of the meteorological information at present in existence is in the hands of the Meteorological Office or can be obtained by them.

* This estimate of 4s. 8d. per mile is worked out by Mr. Holt Thomas in his paper read before the Aeronautical Society of Great Britain on May 30th, 1917, relating to an aerial service between London and Paris. The figure of 4s. 8d. is based on the assumption of a service by one machine each day daily, and it is thought that a fair analogy can be drawn between the London-Paris service and that outlined in the present memorandum. Without in any way criticising Mr. Holt Thomas's figures, it would appear that they rest on what may be called a conservative basis, and that, therefore, the expenses in the present instance are not estimated at too low a figure.

† In the case of dirigibles the distance of 100 metres prescribed above shall be increased to 500 metres.

‡ From 0 degrees (*i.e.*, straight ahead) to 90 degrees on the right hand constitutes the forward quadrant.

Statistical information would be useful for such purposes as choosing routes and the sites for aerodromes and buildings. The statistical information at present obtainable differentiates between areas of 50 or 100 miles square; for instance, between the meteorological conditions which are met with on opposite sides of a mountain chain. But there is as yet little information relating to the local variations in meteorological conditions.

Statistics already collected are available for determining such questions as whether it is better to leave Switzerland on the port or starboard hand in flying to Italy, or whether it would pay to go round southwards by the Azores in flying to America. On the other hand, the statistical information at present available is not capable of discriminating between the average meteorological conditions of two alternative sites for aerodromes situated within a few miles, or even 20 or 30 miles, of one another, except in so far as it shows which of the meteorological conditions are likely to be the same in two neighbouring sites. Statistics show, for instance, that the cloudiness and rainfall in two neighbouring sites may be the same unless special circumstances interfere. On the other hand, fogginess and windiness depend almost exclusively on such local conditions that the present statistics are of little use except for the actual station at which observations were made. Perhaps, later, aerodromes will accumulate their own data.

A small staff at the Meteorological Office would collect the available useful information, but such a staff would have to be directed by someone in touch with aeronautics, in order that the information might be collected and tabulated in the form most useful for flying. He would have to decide such questions as whether frequencies or mean values should be dealt with. In dealing with wind statistics, for instance, it is more useful to know the number of hours during which certain winds blow with certain strengths, and from the various directions, than it is to know the mean wind velocity or direction.

If weather stations are going to be established at terminal and intermediate aerodromes in connection with civil aerial transport, it will be necessary to overhaul thoroughly the character of observations taken, in order that special attention may be paid to the data which are most important.

It is advisable that a system should be organised by which observations are taken and recorded regularly by aeroplanes travelling on defined routes. The work of collecting and comparing these statistics, and the superintendence of instruments might be undertaken by the Meteorological Office.

It has been pointed out by various members of the Committee that civil aerial transport will inevitably have to be worked on international lines. It is impossible to forecast what measure of international co-operation will be possible after the war, but it may be pointed out that for many years previous to the war the International Meteorological Committee has done successful work in organising international exchange of meteorological information and international co-operation in meteorological research. It seems certain that it would be advisable to consult with the aerial transport authorities in the allied countries before deciding on any definite plans for a weather service for aerial transport.

(2) *Forecasting.*

An extension of the present system in operation at the Meteorological Office should provide everything that can be expected in the present state of our meteorological knowledge. The high average correctness of weather forecasts will doubtless be improved.

Present system.—The present system involves taking observations at certain places two or three times a day, and communicating by telegraph with a Central Office, where the weather maps are made and the forecasts issued. Forecasts for 12 or 24 hours ahead at two or three fixed hours should be telegraphed from the Central Office to the termini and intermediate aerodromes.

Directions in which present system could be extended.

1. *Extension of range covered.*—Weather telegrams are already obtained from a few distant places, as Iceland, Cairo and the Azores, and from ships by wireless. The number of distant stations could be increased and the range extended so as to include Russia, the Balkans, North Africa and America. Before the war the observations sent by wireless from ships usually arrived too late to be used in the forecasts, but the growing importance of messages from the Atlantic in connection with aerial transport will make it worth while to organise these reports in such a way that the messages arrive in time. For this purpose fuller co-operation with the Royal Navy and the Mercantile Marine should be sought.

By increasing in this way the number of data on which forecasts are based, it will be possible to increase the size of the region for which the forecast is issued and to make it more accurate in all ways.

2. *Extension in the number of weather conditions predicted.*—At present the forecasts are adapted to the needs of people on the ground or the sea—sailors, farmers, travellers, &c. They might be much more useful to flying men if they were made to include the heights at which clouds are to be expected, and the velocity and direction of the upper winds. The first of these has not yet been attempted, but as the data furnished by aeroplanes become more numerous such forecasts may become accurate and useful. The second, the forecasting of wind at various heights, has already been practised successfully in France by the Meteorological Section there, and there is no reason why it should not be carried out even more successfully over a wider range by the Meteorological Office.

Such forecasts would be facilitated by increasing the number of upper air observations and of those on mountains.

3. *Knowledge of the momentary weather.*—For this purpose the present system is quite inadequate. A continuous weather service would be necessary. All landing grounds would evidently be suitable weather observation stations, and continuous readings and reports could be arranged for, if necessary.

In distributing information two systems could be used. Either the observations could be communicated at frequent intervals, say, every hour, to a Central Office, and could then be telegraphed or telephoned when required to aerodromes, or the observations could be taken only when required and telephoned direct to the termini.

The advantage of the Central Office is that it would have a more comprehensive view of the weather conditions over the whole of Europe, and, moreover, an expert could be kept at the Central Office who would have the present conditions at his fingers' ends, and would know which were liable to a sudden change.

The chief difficulty which is likely to be experienced in this branch of the weather service is that of communicating the observations sufficiently quickly to the termini. It seems probable that the direct method would be quicker than the Central Office method. Another point in favour of direct communication is that the observations taken at an intermediate landing ground are only immediately interesting to the termini of the route on which it lies. These two points appear to us to outweigh the advantages of the Central Office method.

If there is a direct telephone wire along the route or constant wireless communication, the whole problem is greatly simplified. On the other hand, if the ordinary telephone lines have to be used, some sort of priority for weather messages will have to be arranged if they are to be of any real use.

The type of observations which could usefully be taken at the intermediate landing ground needs some consideration. The height of the clouds is one of the most important things for a pilot to know. It would not be difficult to fit a range-finder which would give the height of the clouds at a glance.

The velocity and direction of the wind at various heights is also important but it needs a skilled observer to make a pilot-balloon ascent, and even then the information is not available for about three-quarters of an hour after the balloon is sent off. It seems hardly possible to use pilot-balloons in connection with this branch of the weather service, unless balloons are sent up at regular intervals of two or three hours, and the last result is communicated in response to any enquiry from a terminus.

On the other hand, on a clear day the upper wind at any particular height would be found in a few seconds by means of a smoke-shell fired vertically and timed so as to explode at the right height.

One of the chief functions of the observer at the landing-grounds would be to report the appearance and disappearance of fog on their own aerodrome. This needs no very special training, but trained and experienced observers will be needed at every important aerodrome where upper-air work is carried out, and also at places from which local or general forecasts are issued. A corps of such observers should form an integral part of the military or civil air services, as, in fact, they already form a part of the Royal Naval Air Service.

MONTAGU.

August 21st, 1917. G. I. TAYLOR (Major).

APPENDIX H.

Preliminary Memorandum on Inter-communication between Aircraft and the Ground, and also Inter-communication between Aircraft and Aircraft. [This is not printed.]

APPENDIX I.

Safety Appliances for Commercial Aircraft.

1. The risk of forced landing of aeroplanes is the first of all risks run, and for this two remedial possibilities exist. The most important expenditure on safety and on the general economy of aerial transport is the provision of alighting grounds along the flying routes, and no suggestion herein is put forward in substitution for, or in diminution of, the importance of these route-alighting grounds; the second is the extension of the use of multi-engined aeroplanes. Airships would usually be provided with more than one engine in any case.

2. In considering the detail of appliances to be used in connection with safety on aircraft, regard must be had both to the prevention of accidents and the best method of dealing with the dangers arising after accidents have occurred, whether on the ground before commencing a flight, in the air, or on landing. It must be realised that experience shows that an accident to the machine by no means involves, in the majority of cases, an accident to the flyer and passenger. It is probably that the civil use of aircraft will conduce to much greater safety than the useful standard already reached, quite apart from any appliances—especially since extreme war performance and manœuvring are not called for.

3. *Fire.*—The direction in which study is advisable in all types of aircraft is to try to arrange for the main petrol supply to be situated clear of the hot parts of the engine and away from the magneto, and to see that the exhaust pipes are kept clear of the petrol pipes, and the exhaust discharge is in such a position that a spark cannot ignite any surplus petrol flowing away in the case of over-filling of tanks, or any vapour from exits or leakages. In some engines gauze boxes can be fitted to induction pipes, and the inlet ducts to carburettors arranged to draw the air from outside the structure.

4. Experiments have been made on magnetos by making small alterations to enable them to be immersed in an inflammable vapour, and it has been found that after lowering and raising the pressure on such vapour it did not fire the mixture even when overflow sparks occurred at the safety gap. This preliminary study should be prosecuted, and could probably result in the general introduction of such magnetos. Meanwhile the whole petrol system is kept clear of electrical devices, such as magnetos and wireless, in case leakages of petrol should give rise to vapour in their vicinity. A desirable feature which has been suggested as useful is an arrangement for shutting off the petrol from the jet instantly. This might take the form of a spring-controlled mechanism acting on a needle fitted with a quick thread, which, through the action of a spring, could be made to stop up the jet orifice. The object, which is to ensure the engine stopping quickly when desired, could be effected in various ways, and here also is a field for experimental development. Incidentally this might avoid the danger of an engine running backwards if overheated.

5. All overflow pipes and pipes between the carburettor and the atmosphere are led well outboard, and care is taken in the making of exhaust manifold joints to avoid the danger of their blowing out. In the case of rotary engines, which usually have no exhaust pipes, it is usual to cowl them completely with metal cowls and to keep those supporting members which may come near the exhaust free from exposed inflammable material. Any fuel or oil that may be thrown out from the engine is kept within the cowl, and if it should catch fire no damage results. Nevertheless such cowls should be drained. The aircraft of to-day have, except in the case of airships only, small margin of useful load, and their utility is jeopardised by compulsory carrying of additional weights. Hence fire extinguishers do not form an obligatory equipment until the aeroplane attains considerable dimensions, but it is eminently desirable that they should be carried if possible. Small extinguishers should be available at all aerodromes, but they must not contain ingredients likely to harm fabric or wood work.

6. *Parachutes.*—In airships, kite balloons, and balloons, the use of these, though requiring decision and courage on the part of the user, does not offer the same difficulties as in the case of aeroplanes. It is, however, in the present stage of development inadvisable to jump in a parachute under a height of about 500 ft. As regards aeroplanes, opinion is divided as to the advisability of employing parachutes, both for the above reasons and because there is difficulty in fixing the parachute in such a position that no part of the aeroplane will be fouled when the jump is taken. Moreover, a substantial proportion of the accidents which occur only become accidents after the ground has been reached, or too nearly approached for the parachute to be useful. The best position for a parachute would seem to be either on the underside or on the side of the body, and a comparatively flat and compact parachute case has already been designed for this, and has been successfully employed in experimental flights with airships.

It may be said that parachutes would only be employed in the case of a serious outbreak of fire, or the breakage of some vital part of the machine. In the latter case it would generally be problematical whether the parachute could be got free—in the former, the problem of fire is best dealt with by preventive measures. Meanwhile the carrying out of experiments is to be encouraged.

7. *Air or Land Brakes.*—These have a distinct promise of utility for landing in restricted areas. Several forms of air brake have already been tried with more or less success. As soon as engines have reached a high standard of reliableness a promising form of air brake is the variable pitch and reversible air-screw. Land brakes might take the form of a plough either operated by hand or automatically making contact with the ground. A similar purpose would be served by wings of variable surface or with the camber and angle of incidence capable of being altered. This latter development might come with the further increase of flying speeds which is often foreshadowed.

8. *Instrument for Ascertaining the Attitude of an Aeroplane in a Cloud.*—It is understood that considerable importance is attached to this by pilots.

Neither the ordinary spring-controlled air speed indicator nor the spirit level can be relied upon for this purpose. Only a gravity-controlled instrument gives for steady flight conditions the true angle of incidence irrespective of whether the machine is turning or not. It has been suggested that, but for the extreme weight of the gyrostat, a solution might be found in its adoption, the pilot putting his machine in a horizontal position before entering the cloud and starting the gyrostat, which would continue to indicate the direction in which the axis of the machine was lying at the instant of release. More important than this is the indication of turning, an instrument which shows whether a turn is or is not being made. This relieves us of the evil results of certain peculiarities of the aero compass.

9. *Landing at Night.*—Landing airships at night does not present any great difficulty. The best method has been found to be to place beacon lights on the sheds with a searchlight on the ground pointing up-wind, coupled with streaming lights. The trail rope is also painted white. Some similar system, or petrol or acetylene flares, is suggested for aeroplanes, perhaps coupled with carrying on the machine a searchlight and parachute flares, to illuminate the ground in the event of a forced landing.

10. *Navigation in Fog.*—This is in part a question of illuminating arrangements, as, generally speaking, the fog hardly ever extends beyond 2,000 ft. from the ground, and is purely local. The system adopted in France of firing star shells to burst over the fog might also be developed along commercial routes. Landing grounds should be selected as far as possible in fogless areas, and perhaps advantage for alighting might result from specially treating the ground to keep a dry surface. Research and experiment on the dispersal of fog would also be valuable.

11. *Multiplication of Power Plant in Aeroplanes.*—This has obvious merits in large machines as a guarantee against the results of engine failure. Three engines have some advantage over two.

Four-engined machines with one tractor engine on each wing, and behind it, a pusher engine with the crankshaft in the same line, have been tried and promise well, though they have not yet been fully tried out.

As a matter of useful information required on this class of work it may be said that it has been found that in twin-engined machines it is not necessary to have opposite-handed engines, but that a machine can be flown quite successfully with two right-handed or two left-handed engines. This is an important simplification for the upkeep of such craft.

E. M. MAITLAND,
Wing Captain.
MERVYN O'GORMAN,
Lieut.-Colonel.

November 29th, 1917.

THE ROYAL AIR FORCE

London Gazette, December 17th.

Technical Branch.

P. H. Wellum (Sub-Lieut., R.N.V.R.) is granted a temp. commn. as Sec. Lieut. (Grade A); Nov. 3rd, with seniority April 1st.

The following Cadets are granted temp. commns. as Sec. Lieuts.:—30678 P. Collins; Aug. 27th. S4/174402 E. H. Harrison; Sept. 11th. 184941 G. K. Lindsay; Sept. 23rd. 5044 G. V. Dowding, 127664 E. C. Cousens; Sept. 24th.

Lieut. H. R. South is dismissed the Service by sentence of a General Court-martial; Sept. 17th.

Capt. W. E. G. Ord-Statter (Capt., K.O.R. Lanc. R.) relinquishes his commn. on ceasing to be employed; Nov. 3rd.

The following Sec. Lieuts. relinquish their commns. on account of ill-health and are granted the hon. rank of Sec. Lieut.:—E. S. Daniel, G. L. Meehan; Dec. 18th.

The date of appointment of Maj. S. J. L. Vincent is Aug. 10th, and not as stated on page 1, 139 of *Gazette* Nov. 29th.

The notification in *Gazette* Nov. 15th concerning Capt. R. K. Paton is cancelled.

Medical Branch.

W. G. L. Wambeek (late T. Capt., R.A.M.C.) is granted a temp. commn. as Capt.; Nov. 14th.

The following are granted temp. commns as Lieuts.:—J. B. Barnett, C. H. Young; Dec. 16th.

The regiment of Lieut.-Col. T. D. C. Barry, I.M.S., is as now described, and not as in *Gazette* Nov. 26th.

The notification in *Gazette* Dec. 3rd concerning C. C. Rowland is cancelled.

The surname of Capt. J. C. H. Allan is as now described, and not as in *Gazette* Nov. 26th.

Chaplains' Branch.

Rev. A. J. N. Saunders is granted a temp. commn. as Chaplain with the relative rank of Capt.; Dec. 14th.

Memoranda.

Sec. Lieut. A. G. F. Nash to be actg. Capt. whilst holding a special appointment at the Ministry of Munitions; June 20th.

Sec. Lieut. J. N. Macdonald to take rank and prec. as if his appointment as Sec. Lieut. bore date Oct. 15th.

The notification in *Gazette* May 31st concerning Lieut. C. J. Killeen is cancelled.

London Gazette, December 20th.

The following temporary appointments are made at the Air Ministry:—

Staff Officer, 1st Class. (*Air.*)—Major R D. Waterhouse, and to be Acting Lieut.-Col. while so employed; Dec. 10th.

Staff Officer, 2nd Class.—Maj. S. E. Parker, M.B.E.; Dec. 3rd.

Staff Officers, 3rd Class. (*Air.*)—Lieut. A. J. Clark, and to be Acting Capt. while so employed; Aug. 18th to Nov. 26th. (*P.*)—Lieut. (Acting Capt.) C. A. Mercer, and to retain his acting rank while so employed; Nov. 15th. Capt. S. Brew; Nov. 26th. (Q.)—T. Armstrong (Qr.-Mr. and Maj., T.F., Gen. List) is granted a temp. commission as Capt., and to be Hon. Maj.; April 1st.

Flying Branch.

Maj. G. L. P. Henderson, M.C., to be Acting Lieut.-Col. while employed as Lieut.-Col. (A.); Nov. 22nd.

Maj. (Acting Lieut.-Col.) R. Hilton-Jones retains the acting rank of Lieut.-Col. while employed as Lieut.-Col. (A.) from S.O.; Dec. 10th.

Lieuts. to be Acting Capts. (A.): F. A. Martin; April 11th. L. J. Mann, M.C.; Dec. 3rd.

Lieuts. to be Lieuts. (A.) from Observer Officers: L. V. Foster; Nov. 21st. A. E. Hahn; Nov. 27th. D. McC. Martin; Nov. 28th.

Sec. Lieut. G. T. H. Pack to be Sec. Lieut. (A.) from (T.); April 1st.

Sec. Lieuts. (late Gen. List, R.F.C., on prob.) are confirmed in their ranks as Sec. Lieuts. (A.): F. L. Ross, R. L. Frace; May 29th. H. D. Dade; July 3rd. H. S. McFadden; July 27th. F. Fletcher; Oct. 19th. A. A. Robinson; Nov. 27th. A. A. Adams, L. Dickinson, W. Goldbeck; Nov. 28th. W. J. Tudhope, A. B. Smith; Nov. 29th.

P.F.O. D. H. Grigg (late R.N.A.S.) (since deceased) is granted a temp. commission as Sec. Lieut. (A.); June 2nd.

The following are granted temp. commissions as Sec. Lieuts. (A.): A. K. Sadler (Lieut., Bord. R., T.F.) and to be Hon. Lieut.; Oct. 16th. O. Greening (Capt., Can. Eng., C.E.F.) and to be Hon. Capt.; Nov. 18th G. H. Baker (Lieut., Lond. R., T.F.) and to be Hon. Lieut.; Oct. 21st D. W. Clarke (Sec. Lieut., R.H. and R.F.A.), J. C. Bowie (Sec. Lieut.), Scot. Fus., T.F.); Oct. 23rd. F. B. Norris (Sec. Lieut., Shrops. L.I., T.F.; Nov. 20th. S. K. Bunce (Temp. Lieut., York. and Lanc. R.) and to be Hon. Lieut.; Nov. 21st.

Sec. Lieut. to be Sec. Lieut. Observer Officer from (A.): G. E. McManus; Aug. 8th.

Sec. Lieut. K. R. Bennie to be Sec. Lieut. (O.) from K.B.; Nov. 3rd.

The following Sec. Lieuts. (late Gen. List, R.F.C., on prob.) are confirmed in their ranks as Sec. Lieuts., Observer Officers: W. Bolt; June 3rd. W. N. Ashburner; Nov. 15th.

The following are granted temp. commissions as Sec. Lieuts., Observer Officers:—G. Norrish (Temp. Sec. Lieut., Linc. R.); Aug. 14th. H. F. Richardson (Lieut., E. Ont. R., C.E.F.) and to be Hon. Lieut.; Oct. 19th. F. L. Mitchell (Lieut., C. Ont. R., C.E.F.) and to be Hon. Lieut., S. G. Cockburn (Temp. Sec. Lieut., L'pool. R.), E. T. Griffiths (Sec. Lieut., L'pool. R., T.F.), R. Simpson (Temp. Lieut., Cam. Highrs.) and to be Hon. Lieut.; Oct. 30th. C. Beardmore (Temp. Sec. Lieut., N. Staffs.), H. Chapman (Temp. Sec. Lieut., R.E.), C. Curtis (Sec. Lieut., Hamps. R., S.R.); Nov. 1st G. W. Drowne (Lieut., Manitoba R., C.E.F.). and to be Hon. Lieut., H. G. Cowley (Temp. Sec. Lieut., North'n. Fus.); Nov. 3rd. E. C. Crouch (Temp. Sec. Lieut., Tank Corps), J. F. Blick (Temp. Sec. Lieut., Hamps. R.), C. B. Hancock (Sec. Lieut., Worc. R., T.F.), T. W. Wilson (Temp. Sec. Lieut., York. and Lanc. R.); Nov. 8th. G. W. Bucklow (Temp. Sec. Lieut., Notts. and Derby R.), J. J. Leonard (Sec. Lieut., Conn. Rang., S.R.); Nov. 13th. F. L. S. Kelman (Lieut., High. L.I., T.F.) and to be Hon. Lieut.; Nov. 27th. The following Lieuts. relinquish their commissions on ceasing to be employed: Lieut. T. M. Evans (Lieut., R.E.); Nov. 19th. Lieut. F. G. Mathers (Capt., Manitoba R.); Nov. 23rd. Lieut. A. W. Lewis; Dec. 2nd. Lieut. R. W. White (Capt., E. Ontario R.); Dec. 4th.

The following Sec. Lieuts. relinquish their commissions on ceasing to be employed:—Sec. Lieut. (Hon. Lieut.) J. H. Odell (Lieut., Can. Field Art.); Dec. 2nd. Sec. Lieut. (Hon. Lieut.) N. W. Helwig, D.F.C. (Lieut., 2nd Cent. Ontario R.); Dec. 4th.

Lieut. (Acting Capt.) F. McChesney relinquishes his commission on account of ill-health contracted on active service, and is granted the hon. rank of Capt.; Dec. 21st.

The following Lieuts. relinquish their commissions on account of ill-health and are granted the hon. rank of Lieut.:—S. Cooper, J. J. Gowing (contracted on active service), F. H. Hall (caused by wounds), W. B. Hetherington (contracted on active service), H. W. Ingram (contracted on active service), W. N. P. Jenkin, W. de L. Lauder (contracted on active service), G. H. Mackay, C. J. Page (caused by wounds); Dec. 21st.

The following Lieuts. relinquish their commissions on account of ill-health:—Lieut. (Acting Capt.) J. E. Gurdon, D.F.C. (Sec. Lieut., 3rd Bn. Suff. R., S.R.) contracted on active service), Lieut. L. F. Handford, M.C., (Sec. Lieut., 13th London R., T.F.) (caused by wounds), Lieut. E. P. Hyde (Sec. Lieut., Ches. R., T.F.) (caused by wounds), Lieut. S. S. Hume (Lieut., 1st Co. of Lond. Yeo., T.F.) (contracted on active service); Dec. 21st.

The following Sec. Lieuts. relinquish their commissions on account of ill-health, and are granted the hon. rank of Sec. Lieut.:—E. H. Berry, D. R. Day, W. Kirkpatrick Crockett, H. Gittins (Sec. Lieut., S. Lan. R.) (contracted on active service), A. R. Lee, E. J. Madill; Dec. 21st.

Lieut. E. Cardinal relinquishes his commission having been found physically unsuited as Pilot or Observer, and is granted the hon. rank of Lieut.; Dec. 21st.

The following officers are antedated in their appointments as Sec. Lieuts. (A. and S.), with effect from the dates stated:—W. T. Jones; May 23rd. J. L. Hunter; May. 24th.

The following officer is antedated in his appointment as Sec. Lieut. (A.): M. S. Dickinson; July 14th.

Administrative Branch.

Lieut.-Col. J. W. L. Hunt to be Lieut.-Col., from (S.O.); Dec. 8th.

D. Mackenzie (Maj., New Armies) is granted a temp. commission as Maj.; Nov. 18th, seniority April 1st, and to be Acting Lieut.-Col. whilst employed as Lieut.-Col.

The following Capts. (Acting Majs.) retain the acting rank of Maj. whilst employed as Majs.:—H. B. Montmorency, from (A.), T. C. Rapp, M.C., from (A.); April 1st.

Capt. F. Steel to be Acting Maj. whilst employed as Maj.; Dec. 6th.

The following are granted temp. commissions as Capts, seniority April 1st, and to be Acting Majs. while employed as Majs.:—G. R. Turner (Capt., E. Kent R., S.R.); Sept. 21st. C. P. Cowper (R. War. R., S.R.); Oct. 4th.

Capts. to be Capts.:—G. N. Martin, from (A.); July 31st. C. A. Narbeth, from (A.); Oct. 1st. R. L. Kennedy, from (S.O.); Oct. 11th.

Lieut. (Hon. Capt.) (acting Maj.) S. C. F. Bacon relinquishes the acting rank of Maj., and to be Acting Capt. while employed as Capt., from (S.O.); Nov. 29th.

Lieuts. to be Acting Capts. while employed as Capts.:—J. M. Ogden; April 6th. J. Runciman; Oct. 4th. L. A. Rushbrooke; Nov. 15th. (Substituted for notification in *Gazette*, Nov. 26th.)

Sec. Lieuts. to be Acting Capts. while employed as Capts.:—(Hon. Lieut.) J. A. Bonnyman, from (T.); Oct. 21st. (Substituted for notification in the *Gazette*. Dec. 6th) R. F. Pyke; Nov. 22nd.

Capt. J. A. Carr, D.S.C., to be Lieut., from (S.O.); June 15th.

Lieuts. to be Lieuts.:—J. H. Cross, from (A.); April 1st. L. S. Thompson, from (A.); Dec. 9th.

D. F. Loftus (Capt., G. Gds.) is granted a temp. commission as Lieut., and to be hon. Capt. seniority April 1st; June 20th.

Sec. Lieut. A. J. Litton to be Acting Lieut. while employed as Lieut.; Oct. 4th.

Sec. Lieuts. (late Gen. List), R.F.C., on prob.) are confirmed in their ranks as Sec. Lieuts.:—L. G. H. Aspinall, E. W. Bourne; April 1st. A. R. Knowles July 31st. H. B. Brown; Sept. 12th. R. S. Swanton; Sept. 14th. H. Royston; Oct. 21st. A. E. Peel; Oct. 24th. J. P. Gill; Oct. 27th. P. Mendoza; Oct. 31st. G. Allison-Beer, P. F. Jefford; Nov. 2nd. W. H. Jones; Nov. 3rd. T. Waitt; Nov. 9th. S. Sprenger: Nov. 21st. J. W.

Beskeen ; Nov. 22nd. F. L. Howard ; Nov. 24th. M. A. V. Pumfrey ; Nov. 26th. E. R. Harris ; Nov. 29th.

The following are granted temp. commissions as Sec. Lieuts. :—H. C. Ind (Temp. Sec. Lieut., R.F.A.) ; Oct. 5th. J. E. Slattery (Sec. Lieut., Lan. Fus.) ; Oct. 7th. J. W. Squire (Temp. Sec. Lieut., E. Surr. R.) ; Oct. 25th. R. B. Smith (Sec. Lieut., Worc. R., T.F.) ; Oct. 29th.

The following are granted temp. commissions as Sec. Lieuts., seniority April 1st :—B. Bear, M.M. (Sec. Lieut., E. York R.) ; Sept. 23rd. H. P. Bridges (Temp. Sec. Lieut., York L.I.) ; Oct. 8th. F. Hind (Temp. Sec. Lieut., Lab. Corps) ; Oct. 19th. T. Gill (Temp. Sec. Lieut., R. W. Fus.) ; Oct. 21st. A. J. Corbett (Temp. Sec. Lieut., Lab. Corps) ; Oct. 25th.

Sec. Lieuts. to be Sec. Lieuts., from (T.) :—H. E. Gridley ; Nov, 14th. H. J. Payne ; Nov. 23rd.

Sec. Lieuts. to be Sec. Lieuts., from (A.) :—C. W. Hewson ; Oct. 26th. A. T. Taylor ; Nov. 8th. L. D. Russell, T. S. Millar ; Nov. 9th. V. C. Roxmouth ; Nov. 19th. H. C. Bryant ; Nov. 21st.

Sec. Lieuts. to be Sec. Lieuts., from (O.) :—G. R. Le Cecilia ; Oct. 12th. J. H. Deas ; Nov. 22nd. J. A. Weatherley, C. G. Smith ; Nov. 23rd. F. H. Lythall ; Nov. 26th. H. Pitkin ; Nov. 27th.

Sec. Lieut. W. Hopps to be Sec. Lieut., from K.B. ; Nov. 14th.

I. M. Gee is granted a temp. commission as Sec. Lieut. ; July 3rd.

Appointment of Temp. Lieut. H. J. Cutler is antedated to Oct. 13th.

Notification in *Gazette* Nov. 12th concerning F. W. Crawford is cancelled.

The following Lieuts. relinquish their commissions on ceasing to be employed :—Lieut. A. Tickler (Capt., W. Som. Yeo.) ; Nov. 6th. Lieut. F. H. McCormick (Capt., 3rd Res. Batt. R. Dub. Fus.) ; Nov. 26th.

Maj. E. I. B. Lord Clifton, relinquishes his commission on account of ill-health, and is granted hon. rank of Maj. ; Dec. 21st.

Sec. Lieut. A. C. Sutcliffe resigns his commission to resume dental studies and is granted rank of Sec. Lieut. ; Dec. 21st.

The following Sec. Lieuts. relinquish their commissions on account of ill-health, and are granted hon. rank of Sec. Lieuts. :—L. P. Woodill, A. W. Wright : Dec. 21st.

The following Sec. Lieuts. resign their commissions :—J. A. Scott, J. C. E. Stevens ; Dec. 21st.

The initials of Lieut. R. G. Bishop are as now described, and not as in *Gazette*, Nov. 5th.

Technical Branch.

Maj. C. J. Murfitt to be Maj., from (S.O.) ; Dec. 10th.

Capts. to be Acting Majs. whilst employed as Majs. :—(Hon. Maj.) H. B. Nutting ; Oct. 8th. K. H. McLean ; Nov. 5th. G. L. Godden ; Nov, 19th.

Capts. to be Acting Majs. whilst employed as Majs. (Grade A.) :—J. Gardiner ; Oct. 4th. L. H. B. Cosway ; Oct. 19th.

Capt. W. C. Lambert to be Acting Maj. (Grade B.) ; Nov. 1st.

W. J. Palmer (Lieut., Gen. List, New Armies) is granted a temp. commission as Lieut., April 1st, and to be Acting Capt. whilst holding a special appointment at the Ministry of Munitions ; May 24th. (Substituted for notification in *Gazette*, Oct. 15th.)

Lieuts. to be Acting Capts, whilst employed as Capts. (Grade B) :—E. L. French, H. C. Gaze, H. Maccoy, G. B. Neale, G. R. Thorne ; Oct. 4th. G. Bowen ; Nov. 25th.

Sec. Lieuts. to be Acting Capts. (Grade B) :—Hon. Capt. (Acting Lieut.) T. R. Duff (Hon. Lieut.) F. E. Richardson ; Oct. 4th.

Lieut. W. R. S. Humphreys to be Lieut., from (A.), Grade A ; Nov. 27th.

Sec. Lieut. (Hon. Lieut.) E. A. Gulson to be Acting Lieut. (Grade A) ; Nov. 1st.

Sec. Lieuts. to be Acting Lieuts. (Grade B) :—(Hon. Lieut.) G. E. Barnett, C. E. Ebbutt, J. J. Mackenzie, from (O.) ; Oct. 4th.

Sec. Lieut. H. G. Reddy (Sec. Lieut., 1st Bn., Lond. R., T.F.) relinquishes his commission on ceasing to be employed ; Nov. 1st.

Capt. H. E. Earl (6th Bn., Rif. Brig., S.R.) relinquishes his commission on account of ill-health ; Dec. 21st.

Sec. Lieut. (Hon. Lieut.) A. Ellison relinquishes his commission on account of ill-health, and is granted the hon. rank of Lieut. ; Dec. 21st.

Medical Branch.

The following are granted temporary commissions as Capts., with effect from Nov. 28th, with seniority from April 1st :—F. N. V. Dyer (late Temp. Surg., R.N.), J. Paxton (late Temp. Surg., R.N.), J. Souter (late Temp. Surg., R.N.).

Chaplains' Branch.

The Rev. P. C. C. Lamb (Temp. Chap. to the Forces, 4th Class, A.C.D.) is granted a permanent commission as Chaplain with the relative rank of Capt. ; Dec. 17th.

The Rev. N. T. Hopkins (Temp. Chap. to the Forces, 4th Class, A.C.D.) is granted a temporary commission as Chaplain with the relative rank of Capt. ; Dec. 19th.

Memoranda.

Major-Gen. W. S. Brancker, A.F.C. from R.A., is granted a permanent commission as Major-General ; Aug. 23rd.

Lieut. (acting Capt.) C. S. Willmott relinquishes his appointment as (S.O.) and acting rank ; Nov. 7th.

Lieut. (acting Capt.) J. W. Young relinquishes the acting rank of Capt. on ceasing to be specially employed ; Dec. 5th.

Sec. Lieut. F. H. S. David relinquishes his commission on ceasing to be employed ; Nov. 6th.

C. Dean (late Sec. Lieut., R.A.F.) is granted the hon. rank of Sec. Lieut. ; Dec. 14th.

The following Capts. are confirmed in the rank of Capt. :—B. E. Harrison, C. F. Brewerton, D.S.C., H. L. Everitt, A.F.C., A. T. Sketchley, E. S. Goodwin, A.F.C., E. E. Maitland-Heriot, D.S.C., J. W. B. Grigson, D.F.C., C. A. Rea, A.F.C., V. R. Gibbs, D.S.C., W. S. Wilson, Rhys Davies, C. Boumphrey, O. C. Le Boutillier, J. G. Ireland, A.F.C., G. W. Biles, E. M. Morgan, J. W. Hobbs, E. R. Pritchard, A. W. Farquhar, S. M. Kinkead, D.S.C., D.F.C.

London Gazette, December 24th.

The following temporary appointment is made :—

Staff Officer, 4th Class.—(1st Grade) D. C. Hyde (Temp. Capt., N. Staffs. R.), and is granted a temp. commn. as Capt. ; Sept. 21st.

Flying Branch.

Lieut. C. T. Black to be acting Capt., whilst employed as Capt. ; July 31st.

F. W. Freeman (Temp. Sec. Lieut., Essex R.) is granted a temp. commn. as Sec. Lieut., Observer Officer ; June 6th (substituted for the notification in *Gazette*, December 10th, in which he is described as a Flight Cadet). 4992 Flight Cadet M. Fraser is granted a temp. commn. as Sec. Lieut. (A. and S.) since deceased) ; July 19th.

W. T. Armstrong is antedated in his appointment as Sec. Lieut. (A.), with effect from Sept. 14th.

H. J. G. Rudolf is antedated in his appointment as Sec. Lieut. (A. and S.), with effect from May 16th.

The following are granted temp. commns. as Sec. Lieuts. (K.B.) :—R. C. E. Vernede (Sec. Lieut., R.F.A., S.R.), F. W. Dunnett, M.C. (Sec. Lieut., R.F.A., S.R.), E. F. Murphy (Sec. Lieut., R.G.A., S.R.) ; Nov. 10th. R. H. W. Davidson (Lieut., R.F.A., T.F.), and to be Hon. Lieut. E. H. Macmanus Lieut., R.F.A., T.F.), and to be Hon. Lieut. ; Nov. 13th.

Capt. G. W. M. Grover (Lieut., R. Marine Art.) relinquishes his commn on ceasing to be employed ; Nov. 24th.

Major J. K. Aird relinquishes his commn. on account of ill-health, and is granted the hon. rank of Major ; Dec. 25th.

The following Lieuts. relinquish their commns. on account of ill-health, and are granted the hon. rank of Lieut. :—J. M. Dowsett (contracted on active service), J. W. Giliis (contracted on active service), D. W. Hughes (contracted on active service), F. C. Smith (caused by wounds) ; Dec. 25th.

Sec. Lieut. E. W. Henry resigns his commn. to resume Medical Studies, and is granted the hon. rank of Sec. Lieut. ; Dec. 25th.

The following Sec. Lieuts. relinquish their commns. on account of ill-health, and are granted the hon. rank of Sec. Lieut. :—C. J. Allen, F. W. Chester (contracted on active service), A. H. Garland ; Dec. 25th.

The following Lieuts. relinquish their commns. on account of ill-health :—A. C. Dunlop (Lieut., R.E.) (contracted on active service), E. C. Gilroy ; Dec. 25th.

Lieut. C. G. Holbeche resigns his commn. ; Dec. 25th.

Lieut. J. G. H. Jackson resigns his commn., having been found physically unsuited for the duties of Pilot or Observer ; Dec. 25th.

Administrative Branch.

Capt. F. V. Cowell to be acting Major while employed as Major ; Oct. 30th.

Lieuts. to be acting Capts. whilst employed as Capts. :—H. G. Jones ; April 1st. (Substituted for notification in *Gazette* Dec. 13th.) (Hon. Capt.) A. Broomer ; July 8th. P. J. Gething, M.C. ; Nov. 4th.

G. Prater (Capt. and Qr.-Mr., Spec. List) is granted a temp. commn. as Lieut., and to be Hon. Capt. ; Oct. 14th.

W. S. J. H. Coney (Temp. Lieut. D. of Corn. L.I.) is granted a temp. commn. as Lieut. ; April 1st. (Substituted for notification in *Gazette* Nov. 8th.)

Lieuts. to be Lieuts. :—A. Bevan (from A.) ; Oct. 11th. D. W. Marriott (from A.) ; Nov. 2nd. W. M. M. Hurley (from A) ; Nov. 7th. C. Wrigglesworth (from O.) ; Nov. 21st. L. V. Labrow (from A.) ; Dec. 4th.

Sec. Lieuts. to be Lieuts. :—Hon. Lieut (Acting Lieut.) G. L. Bennett, (Acting Lieut.) G. Barfoot-Saunt, F. C. Berkeley, (Acting Lieut.) A. E. Biggs, (Acting Lieut.) S. B. Browning, (Acting Capt.) G. T. Bridgewater, (Hon. Lieut.) (Acting Lieut.) E. Butler, G. P. Colin, H. B. Dakin, (Acting Lieut.) F. E. B. Duff, (Hon. Lieut.) (Acting Lieut.) E. H. Eldridge, C. C. Gardner, (Hon. Lieut.) (Acting Capt.) J. W. Gardner, (Acting Lieut.) H. D. Higham, (Hon. Lieut.) (Acting Lieut.) P. Maggs (Hon. Lieut.) (Acting. Capt.) G. B. Redgrave, (Hon. Lieut.) (Acting Lieut.) J. H. Thorpe ; April 2nd. H. F. G. Findlay ; April 3rd. W. D. Littlewood ; April 8th. (Acting Capt.) J. R. Bingham ; April 12th. (Hon. Lieut.) F. Avison ; April 26th. (Acting Lieut.) J. H. Wright ; April 30th. (Hon. Capt.) F. Grave ; May 2nd. (Acting Capt.) H. W. Prockter, (Acting Lieut.) D. H. Eteridge ; May 5th. (Hon. Lieut.) M. A. Robinson ; May 11th. H. Coggins ; May 30th. H. Bridgewater ; June 2nd. (Acting Lieut.) H. L. Dawson, (Acting Lieut.) A. Miller, P. W. Renshaw, (Acting Lieut.) J. C. F. Williams ; June 8th). (Acting Lieut.) K. M. Grahame, W. H. Hume, (Acting Lieut.) R. E. Roberts, W. F. Swan ; June 19th. (Acting Capt.) M. M. Merriman ; July 1st. F. C. Smith ; July 4th. F. H. Isitt ; July 12th. (Hon. Lieut.) A. J. Cassidy ; July 26th. (Acting Lieut.) B. S. Higgs ; Aug. 9th. (Acting Lieut.) C. Guthrie ; Aug. 12th. A. J. Chambers, W. Luke ; Aug. 27th. R. Bradford, M.C., A. L. Underwood ; Sept. 1st. J. McK. Hooper, T. W. A. Jackson ; Sept. 5th. (Acting Lieut.) A. L. Freeman ; Sept. 9th. (Acting Lieut.) W. Brackenbury ; Sept. 10th. A. MacNamara ; Sept. 17th. L. W. H. Bertie ; Sept. 19th. H. W. Denton ; Sept. 22nd. C. B. Charlewood ; Sept. 24th. A. Henderson, J. W. Mennie ; Sept. 28th. (Acting Lieut.) F. Freeman, L. B. Lyle ; Oct. 5th. (Acting Lieut.) P. A. Wright ; Oct. 11th. W. J. C. Brown, (Acting Capt.) R. Tait ; Oct. 13th. (Acting Lieut.) H. E. Storey ; Oct. 20th. R. W. P. Butler, A. D. Jack ; Oct. 26th. H. F. D. Lane ; Nov. 3rd. (Acting Lieut.) H. F. W. Farquharson, T. A. E. Layborn ; Nov. 4th. (Acting Lieut.) R. C. Clements ; Nov. 5th. (Acting Lieut.) F. Feeny ; Nov. 9th. (Acting Lieut.) G. H. Wiggins ; Nov. 11th. M. R. Williams ; Nov. 23rd. R. Boyle ; Nov. 26th. Acting Capt. G. M. Bell ; Nov. 30th. (Acting Capt.) W. A. Carroll ; Dec. 1st. E. C. Haggart ; Dec. 7th. A. G. Lewis ; Dec. 15th. W. H. Savery ; Dec. 20th. (Acting Lieut.) L. Hawkins ; Dec. 23rd. (Acting Lieut.) H. Castle, A. Hancock ; Dec. 27th.

Sec. Lieuts. to be acting Lieuts. whilst employed as Lieuts. :—(Hon. Lieut.) J. A. Allen ; May 15th. B. U. Wood ; July 26th.

The following Sec. Lieuts. (late Gen. List, R.F.C., on prob.) are confirmed in their ranks as Sec. Lieuts. :—S. A. E. Cowell ; Aug. 24th. J. L. Rogers ; Sept. 27th.

Sec. Lieut. E. B. Appleby to be Sec. Lieut. from (A.) ; Nov. 30th.

The name of Arthur Bracy Langridge is as now described, and not as in *Gazette* ; Dec. 17th.

Major G. C. Riley (Major, Royal Canadian Horse Artillery) relinquishes his commn. on ceasing to be employed ; Dec. 17th.

The following Sec. Lieuts. relinquish their commns. on account of ill-health, and are granted the hon. rank of Sec. Lieut. :—E. Apthomas, A. W. Long, G. A. Margetts ; Dec. 25th.

Technical Branch.

Maj. S. J. L. Vincent (Spec. List) is granted a temp. commission as Maj. ; Aug. 10th.

Capts. to be Acting Majs. whilst employed as Majs. :—A. Clayton (Hon. Maj.) A. E. Hatton, R. K. Paton, A. D. S. Rice ; Oct. 30th.

Lieut. F. R. Adams to be Acting Maj. whilst employed as Maj. ; Oct. 30th.

Sec. Lieuts., Acting Lieuts., to be Actg. Majs. whilst employed as Majs. :—O. C. Lees, A. J. Toomer ; Oct. 30th.

Capt. A. B. Davies to be Capt., from (Ad.) ; Oct 1st.

Lieuts. to be Acting Capts. whilst employed as Capts. :—B. S. Crimp, H. W. G. Drummond, R. P. Grant, S. T. Heath, H. V. Snook, (Hon. Capt.) G. R. G. Topham ; Oct. 30th.

Lieut. H. T. Woodhead to be Acting Capt. whilst employed as Capt. (Grade B) ; April 1st.

Sec. Lieuts. (Acting Lieuts.) to be Acting Capts. whilst employed as Capts. : C. A. Assiter, L. H. Bainton, L. A. Hooper, H. D. Staniar ; Oct. 30th.

Sec. Lieuts. to be Acting Capts. whilst employed as Capts. :—(Hon. Lieut.) H. C. Bishop, W. G. Browne, E. W. Dawson, J. E. Koefod, C. H. Quelch ; Oct. 30th.

Sec. Lieuts. to be Acting Capts. whilst employed as Capts. (Grade B) :—(Acting Lieut.) J. F. Alexander, H. L. Bown, H. V. Cherry, F. A. Cherry, A. C. Truelove, J. H. Tanton, A. H. Warriner ; Oct. 30th.

Sec. Lieut. (Hon. Lieut.) R. P. Graham to be Temp. Lieut. whilst employed as a Lieut. ; July 16th. (Substituted for notification in *Gazette*, Sept. 17th.)

Lieuts. to be Lieuts. (Grade A) :—G. S. Wood, from (A.) ; July 17th. G. W. Hulton, from (O.), C. J. Mahoney, from (O.) ; Oct. 18th.

Sec. Lieuts. to be Acting Lieuts while employed as Lieuts. :—J. Dale, E. J. Hindsley, S. Jupp, H. D. Oliver, H. E. Powell, B. E. D. Pratt, H. F. Wilkins ; Oct. 30th.

Sec. Lieuts. to be Sec. Lieuts. (Grade A) from Admin. :—H. R. Moffatt, W. A. Westley ; July 1st. A. E. Simmonds : Aug. 11th. H. G. Wallis ; Sept. 2nd. J. A. McDonald ; Oct. 1st. W. Blairman ; Oct. 28th. N. F. S. Hecht ; Nov. 10th. H. G. Hawkes ; Nov. 16th. A. J. Cook, P. J. Rixon, E. B

Cooke, A. R. N. Challacombe, J. Brereton, R. R. Powell, F. C. Gibson, J. A. Squire; Nov. 17th. J. J. Hegan, E. S. Olney; Nov. 18th. R. Wylie; Nov. 19th. D. L. Kane; Nov. 28th. D. H. Lumb; Dec. 2nd. R. A. Stoker; Dec. 10th.

Sec. Lieut. (Acting Lieut.) D. A. Tullis to be Sec. Lieut., from S.O., and relinquishes his acting rank of Lieut.; April 29th.

V. Sands (Sec. Lieut, Middx. R., T.F.) is granted a temp. commission as Sec. Lieut.; Sept. 30th, and with seniority from April 1st.

G. Pitt (Temp. Lieut., R.E.) is granted a temp. commission as Lieut.; Nov. 5th, and with seniority from April 1st.

H. P. Rashleigh to be Sec. Lieut., and to be Hon. Capt.; Nov. 16th, and with seniority from April 1st.

Sec. Lieut. G. F. Henderson to be Sec. Lieut., from (A.); Dec. 10th

Sec. Lieut. C. Reynolds to be Sec. Lieut., from (A'ship); Nov. 7th.

Sec. Lieut. R. L. T. Latour (late Gen. List, R.F.C., on prob.) is confirmed in his rank as Sec. Lieut.; Nov. 18th.

Sec. Lieuts. to be Sec. Lieuts., from (A.):—A. H. Mitchell; July 9th. G. T. H. Pack; Oct. 1st.

The following Sec. Lieuts. (late Gen. List, R.F.C., on prob.) are confirmed in their ranks as Sec. Lieuts. (Grade B):—M. Bateson; Oct. 18th. C. F. Scholefield, H. G. McKechnie; Nov. 17th.

The following Sec. Lieuts. (late Gen. List, R.F.C., on prob.) are confirmed in their ranks as Sec. Lieuts.:—E. C. Bolton, W. C. Farley; Nov. 17th. H. C. Dalglish, H. C. B. Good, C. H. Ashworth, A. West; Dec. 3rd.

Lieut. N. Couve to be Sec. Lieut., and to be Hon. Lieut., from Observer Officer; Nov. 21st.

Sec. Lieuts. to be Sec. Lieuts.:—J. L. Tait, from Observer Officer; Nov. 16th. W. C. Francis, from (A.); Nov. 18th.

F. H. Jones to be Sec. Lieut., from Sec. Lieut. (Acting Lieut.) Admin., at his own request, and to relinquish his acting rank as Lieut.; Nov 11th.

The following are granted temp. commissions as Sec. Lieuts., seniority April 1st.:—A. M. Mulliner (Temp. Lieut., R.W. Surr. R.), and to be Hon. Lieut.; July 15th. S. L. Boothroyd (Temp. Sec. Lieut., Lab. Corps); Oct. 22nd.

Sec. Lieuts. to be Sec. Lieuts. from (Admin.);—C. W. Richardson; Sept. 10th. G. E. Litton; Oct. 8th. A. Potter; Oct. 30th. R. F. Tunmer; Nov. 18th. H. R. Stubbington; Nov. 25th. A. F. Dodd; Dec. 9th.

Lieuts. to be Sec. Lieuts., and to be Hon. Lieut. from (Admin.) (Grade B):—I. S. Thomas; Oct. 28th. J. J. Iremonger; Nov. 18th.

Lieut. S. D. Carpenter to be Sec. Lieut., and to be Hon. Lieut. from (A.) Nov. 18th.

Sec. Lieuts. to be Sec. Lieuts. from (Admin.):—H. G. C. Plumridge; Sept. 5th. J. M. Blake, F. Anderson; Sept. 10th. A. E. Firth; Oct. 5th. T. Mattocks; Oct. 16th. O. P. Aarvold; Nov. 1st. W. N. Doble; Nov. 2nd. H. S. M. Coster; Nov. 8th. P. F. Garnett; Nov. 10th. H. E. Fenton; Nov. 13th. A. J. Green, A. J. Higgins; Nov. 16th. T. Wright, G. Dunn, N. W. Chandler, E. W. Husband, S. T. Phillips, J. Norman, W. A. A. Joyner; Nov. 17th. R. F. Wilson (date of 1st commission, Oct. 13th). L. J. S. Sterlini, F. G. Thompson, A. R. Matthews; Nov. 18th. H. S. Gain; Nov. 19th. L. R. Merifield; Dec. 1st. S. J. Laidler, F. B. Jeffries, C. W. M. Sabine, T. W. Vanderpump; Dec. 3rd. J. Mutimer; Dec. 9th. A. W. Spice; Dec. 11th. F. J. Nicholson, L. J. Ford; Nov. 17th. C. W. Cornell, J. Sewell, T. Bell, S. Warburton, A. J. Knight, J. H. Hankins, J. Witton, W. J. Wilkinson, C. R. Orchard; Nov. 18th. S. J. Collcutt, V. J. Atterton, W. Blakemore, A. H. Allen; Nov. 20th. G. Hobson; Nov. 21st. E. G. Pugh, G. S. Crowther, G. C. Harrison; Nov. 24th. F. W. Turner, J. Weeks, A. Sowdon; Nov. 25th.

The name of Maj. L. G. Harber is as now stated, and not as in *Gazette*, Dec. 13th.

Sec. Lieut. (Acting Lieut.) V. A. Cooper relinquishes his commission on account of ill-health, and is granted the hon. rank of Lieut.; Dec. 25th.

Lieut. T. J. Owen relinquishes his commission on account of ill-health, contracted on active service, and is granted the hon. rank of Lieut.; Dec. 25th.

Memoranda.

Capt. (Acting Lieut.-Col.) M. Nicholson, M.B.E. (Lieut., Temp. Capt., R.F.A.) relinquishes his commission on account of ill-health contracted on active service; Dec. 25th.

Capt. (Acting Maj.) E. S. Halford is granted the acting rank of Lieut.-Col. whilst specially employed, without pay and allowance of that rank; Dec. 13th.

Sec. Lieut. D. W. Moscrop relinquishes his commission on ceasing to be employed; Sept. 28th.

E. L. Day (late Sec. Lieut., R.A.F.) is granted the hon. rank of Sec. Lieut.; Oct. 19th.

London Gazette, December 27th.

Memorandum.

The notification which appeared in the *Gazette* of Dec. 6th, in so far as Lieut.-Col. (Actg. Brig.-Gen.) G. Livingston, C.M.G., is concerned, is cancelled.

To the North Pole by Aeroplane

THE Aero Club of America is actively at work on a proposal to send an expedition in charge of Capt. R. A. Bartlett to the Arctic in June next. It is proposed to organise a base at Etah, 600 miles from the North Pole, for the vessel going across to Melville Bay. For the final flight, and for the exploration of the polar regions a large sea or land aeroplane will be used, while smaller machines will be used for scouting purposes. The scouting planes would establish a base at Cape Columbia, from which point the large machine would fly from the American side of the Cape over the Pole to Cape Chelyuskin on the Siberian side. Rear-Admiral Peary is one of the principal movers in the scheme.

A British Expedition Also

IT is understood that there is a possibility of a British expedition to visit the North Pole by aeroplane being ready to start in April. It is being organised by Mr. F. W. Salisbury Jones, of the Northern Exploration Company, and will go *via* Spitzbergen. Capt. Wild, who was second in command to Sir Ernest Shackleton's South Polar expedition, is to direct operations, and a landing-place is in course of construction at Lowe Sound.

Venice Bomber Arrested

ACCORDING to a report from Rome, Capt. Banfield, the crack Austrian pilot, who dropped bombs on Venice, has been arrested in Trieste, where he was posing as a merchant engaged in the sale of aeroplanes.

The 1914-1915 Star

REGULATIONS have now been issued by the Admiralty and the Army Council regarding the 1914-1915 Star, which will be awarded to officers and men who served in a theatre of war before December 31st, 1915. The decoration will be a bronze star, similar to the 1914 star, and the ribbon will be red, white and blue, shaded and watered. Trained pilots and observers and men of the R.N.A.S. employed in flying from naval air stations on overseas patrol are entitled to the decoration.

The visit of Lord Weir to the National Aeroplane Factory, Crossley Motors, Ltd., Manchester. From left to right, front row, Major Baird, Brig.-Gen. R. K. Bagnall-Wild, C.M.G., Lord Weir, the Lady Mayoress of Manchester, Sir Kenneth Crossley, Bart., Mr. W. M. Letts, C.B.E., and the Lord Mayor of Manchester.

SIDE-WINDS

ALTHOUGH there were a goodly number hankering after the Michelin Prize in 1911, it was not a Mr. Hanker who "lifted" it, but our old and well-tried friend Mr. Hawker. The little slip in this connection a fortnight ago when referring to a few Sopwith reminiscences, to the initiated was obvious, but we make the correction now for the benefit of any who may have accepted the Hanker as correct. Investigation into the "mishap" still leaves us trying to apportion responsibility between Christmas itself, a compositor who had stalked down successfully a week in advance coupon-less "N," and the sub-editor who missed passing this page, whilst trying to keep unmixed two weeks' issue of "FLIGHT" going to press practically simultaneously, as a necessary sacrifice to the Christmas holiday demands.

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AT a little dinner to the staff held at the works of the Lang Propeller Ltd., on December 18th, the interesting information was divulged by Mr. S. May, general manager and president, that the total number of propellers turned out from the works had risen from 250 in 1914 to 15,000 in 1918, an increase of output of 6,000 per cent. During the evening an excellent concert was provided, to which Miss Rene Bearman, Mr. E. Jones, Mr. T. Linnegar and Mr. Ben Lawes contributed.

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THE eleventh annual dinner of the Acetylene Equipment Co., Ltd., of D.A. fame, held on Saturday, December 21st, at the Holborn Restaurant, was a very enjoyable affair. Mr. L. M. Fox occupied the chair, and one of his most popular announcements during te evening was to the effect that the directors intended to pay all "Christmas boxes" as last year. After the usual loyal toasts, Mr. P. W. Watts, in proposing a toast to the firm, emphasised the necessity for unity during the strenuous times in the future, if the position of the firm was to be maintained. Miss Hope Jackson commenced the musical portion of the programme with "Land of Hope and Glory," the company heartily joining in the refrain. It was evident during the evening that there is no lack of good feeling and harmonious understanding between the D.A. directors and their workers, which augurs well for the future.

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IN order to bring out more fully the nature of their business, the Forward Motor Co. have decided to change the designation of the firm to The Forward Sparking Plug Co., by which style they will be known in future. The proprietorship remains as hitherto, and the company wish it to be clearly understood that their general trade policy will in no way be changed.

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WITH the abolition of the priority regulations of the Min- of Munitions relative to the repair of motor parts comes a notification from Barimar Ltd., Scientific Welding Engineers, of 10, Poland Street, London, W. 1, indicating that the company are now able to undertake all classes of welding work and radiator and lamp repairs without priority certificates for readers of "FLIGHT." The cessation of hostilities on the battle fronts has had the effect of releasing for commercial and private purposes expert labour and plant hitherto solely employed on work of national urgency, and Barimar, Ltd., are now able to undertake speedy, economical repairs on all those classes of work for which the company has justly become world-famous. It may be of interest to note that Barimar, Ltd., has been asked to establish branches of their business in France, Italy, Belgium, Spain, the Netherlands, Greece, Egypt, South Africa, China, India and Australia, and negotiations are now in progress.

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COMPANY MATTERS

Crossley Motors, Ltd.

PRESIDING at the eighth ordinary general meeting on December 23rd, Sir Kenneth Crossley, Bart., said: We regret that it is not yet possible to present the accounts for the period under review, but we hope it will not be very long now before everything is adjusted, and we are able to hold an adjourned meeting for the purpose. In the meantime, we know enough about the position to make us feel safe in recommending a 10 per cent. dividend for the year ending October 31st last. This is not an extravagant return considering the enormous developments we have made during the last few years, but you must realise that we shall want a good deal of money in the near future, and it is only prudent to conserve our resources.

Our company has been very fortunate in having been able, ever since the outbreak of War, to concentrate its energies on the work for which it was formed, viz., the production of motor cars. You may remember that as far back as 1913 the Royal Flying Corps, after the most extensive trials, adopted our 25-30 h.p. model as the standard for all their light, fast and most responsible work, and they have never wavered in their allegiance to it from that day to this. We have delivered over 5,000 of these vehicles, starting with an average of 30 a month and working up to 250 a month, and our managing director tells me he has been assured again and again by officers and men who have had the real experience under every sort of condition abroad that there is no car to touch the "Crossley" on active service; and similar reports come from all the various fronts. We are fortunate because we can almost at once start turning out our post-War 25-30 h.p. R.F.C. model, which, with certain improvements and refinements previously arranged for, to render it suitable for peace instead of war, seems likely to be the most popular car we have ever produced, and we are in a position to carry on the manufacture without any break in the regular output. Later on, with its very large and splendidly equipped works; the company expects to be able to meet any competition with regard to smaller models.

Now, motor cars only represent one portion of our activities. We have been, and are still, turning out large numbers of aeroplane engines from our own works at Gorton, and also complete aeroplanes from the National Aircraft Factory, at Heaton Chapel, which we control on behalf of the Government. We originally built these latter works, of which the machine and erecting shops alone cover nearly 25 acres, as our own factory, the Government helping us financially, but as, when it was almost complete, the authorities were anxious to have it as a National factory, we raised no objection provided we were given a definite option to re-purchase the whole property within a reasonable period after the War, and subject to reasonable depreciation. This option we now hold.

Although the next few months will be difficult, we hope not only that there will be no need seriously to reduce the number of our employees, but that we may soon be in a position largely to increase them. Think of the aircraft business alone. We are on the eve of the biggest development that the world has ever seen—a development so irresistible and natural, and ultimately beneficial, that nothing can delay it for very long.

We shall leave nothing undone that will help us to maintain good relations with our own workpeople. Now the rush is over all good employers will welcome high wages and shorter hours if only the men will play the game and do all they can to encourage and not limit production.

Sir Kenneth Crossley paid a tribute to the energies of Mr. W. M. Letts, C.B.E., managing director, Mr. Shuttleworth, secretary, Mr. Hubble, works manager, and the heads of departments.

The report was adopted unanimously, and Capt. E. A. Crossley was re-elected a director.

Triplex Safety Glass

FINAL dividend of 5 per cent., making 10 per cent. for the year.

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